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## FINAL REPORT

### CABOT OIL & GAS CORPORATION HEITSMAN #2V/#4H WELLSITE DIMOCK TOWNSHIP, PENNSYLVANIA

*Prepared for:*



Cabot Oil & Gas Corporation  
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Pittsburgh, Pennsylvania 15276

*Prepared for:*



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501 Holiday Drive, Suite 300  
Pittsburgh, PA 15220

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MAY 2010

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## TABLE OF CONTENTS

FINAL REPORT SUMMARY.....	i
1.0 INTRODUCTION.....	1
1.1 Objectives .....	1
1.2 Scope of Work Performed.....	2
2.0 SITE DESCRIPTION.....	3
2.1 Location.....	3
2.2 Site History.....	3
2.3 Remedial Activities and Remedial Investigation Activities.....	5
2.3.1 Heitsman #2V Mud Release .....	5
2.3.2 Heitsman #4H Frac Fluid Releases .....	6
3.0 GEOLOGIC AND HYDROGEOLOGIC SETTING .....	8
3.1 Site Soils/Surficial Geology .....	8
3.2 Surface Water .....	8
3.3 Regional Geology.....	9
3.4 Regional Hydrogeology.....	9
4.0 SELECTION OF CONSTITUENTS OF POTENTIAL CONCERN AND SELECTION OF REMEDATION STANDARDS.....	10
5.0 REMEDIAL INVESTIGATION, SITE REMEDIATION AND CONFIRMATIONAL SAMPLING...	12
6.0 FATE AND TRANSPORT ANALYSIS .....	18
7.0 SITE CONCEPTUAL MODEL.....	19
8.0 ECOLOGICAL SCREENING ASSESSMENT.....	20
9.0 SELECTION OF REMEDIATION STANDARDS .....	21
10.0 ATTAINMENT DEMONSTRATION .....	22
10.1 Soil .....	22
10.2 Groundwater .....	24
10.3 Surface Water .....	24
10.4 Vapor Intrusion.....	24
10.5 Post Remediation Care Plan.....	25
11.0 ENVIRONMENTAL COVENANT .....	26
12.0 CONCLUSIONS.....	27
13.0 REFERENCES.....	31

## TABLES

Table 1	Analytical Results – Stevens Creek Samples – May 12, 2009, Heitsman #2V Wellsite
Table 2	Analytical Results – Surface Water – Heitsman #2V/#4H Wellsite
Table 3a	Analytical Results – Sludge Sample (Solid Fraction) – Heitsman #2V/#4H Wellsite
Table 3b	Analytical Results – Sludge Sample (Liquid Fraction) – Heitsman #2V/#4H Wellsite
Table 4	Analytical Results – Confirmational Sample Results for VOCs and SVOCs in Soil – Heitsman #2V/#4H Wellsite
Table 5	Analytical Results – Confirmational Sample Results for Metals in Soil – Heitsman #2V/#4H Wellsite
Table 6	Analytical Results – Synthetic Precipitation Leaching Procedure Results for Metals in Selected Soil Samples – Heitsman #2V/#4H Wellsite
Table 7	Analytical Results – Background Sample Results for Metals in Soil – Heitsman #2V/#4H Wellsite

## FIGURES

Figure 1	Site Vicinity Map
Figure 2	Area of Impact – Heitsman #2V Mud Release
Figure 3	Heitsman #4H Site Layout Drawing
Figure 4	Heitsman #4H Well Pad Schematic
Figure 5	Area of Impact – Heitsman #4H Frac Fluid Release
Figure 6	Water Sampling Locations – Heitsman #4H Frac Fluid Release
Figure 7	Sampling Locations – Heitsman #2V/#4H Mud and Frac Fluid Releases
Figure 8	Area Impacted by Drilling Mud and Frac Fluid – Heitsman #2V/#4H Area

## APPENDICES

Appendix A	Notice of Intent to Remediate, Newspaper Publication, and Municipal Notification Documentation
Appendix B	Site Photographs
Appendix C	MSDS LGC-35CBM

Appendix D	Disposal Documentation Mud Release
Appendix E	Disposal Documentation Frac Fluid Releases
Appendix F	Laboratory Analytical Reports
Appendix G	Statistical Comparison of Lead and Cobalt Concentrations in Soils/Sediment in Remediated Areas Compared to Background Concentrations

## FINAL REPORT SUMMARY

Cabot Oil & Gas Corporation (Cabot) operates the leased wellsite designated as Heitsman #2V and Heitsman #4H in Dimock Township, Susquehanna County, Pennsylvania (Wellsite). The Wellsite is a portion of a larger tract that consists of approximately 209 acres and is leased from Anne Heitsman to explore for and produce natural gas.

During various drilling operations to install the Heitsman #2V and Heitsman #4H wells (co-located on the same well pad), four separate releases occurred: a drilling mud release in the vicinity of the Heitsman #2V well on May 6, 2009 and three “frac fluid” releases that occurred on September 16, 2009 (two releases) and September 22, 2009 (one release) in the vicinity of Heitsman #4H well.

The May 6, 2009 drilling mud release consisted of water-based mud that flowed to a low point beside the well pad and toward the hay bales [Erosion & Sedimentation (E&S) controls] protecting a nearby wetland and Stevens Creek. The drilling mud release was properly reported to the Pennsylvania Department of Environmental Protection (PADEP). The drilling mud breached the hay bale barrier by flowing under the hay bales and, subsequently, entered the wetland. The drilling mud is black in color; therefore, the extent of the area of impact could be easily determined visually. The drilling crew was able to create an earthen dam at the outflow where the wetland would normally have entered Stevens Creek and thus, prevented drilling mud from impacting Stevens Creek. The drilling mud was subsequently flushed from the wetland back up to the well pad and disposed of properly.

There were three (3) distinct releases of frac fluid at the Heitsman #4H wellpad. Two releases occurred on September 16, 2009 and a third release occurred on September 22, 2009. All three frac fluid releases were properly reported to the PADEP.

The frac fluid is a mixture consisting of fresh water and a proprietary liquid gel concentrate called LGC-35 CBM, or “frac gel” supplied by Halliburton that is mixed at a ratio of 5 gallons of frac gel to 1,000 gallons of fresh water, resulting in a mixture that is 99.5 percent water and 0.5 percent frac gel.

The frac fluid releases at the Heitsman #4H location were caused by equipment failures resulting from pressure surges in the water transfer system. A factor contributing to the pressure surges was the elevation difference of approximately 240 feet between the frac tank farm where the water source was stored and the wellpad. The hydrostatic pressure resulting from this elevation difference, combined with pressure fluctuations associated with fracing, resulted in the pressure rating of some piping components being exceeded. Similar topographic conditions have not been encountered at other Cabot fracing locations.

Frac fluid released on September 16, 2009 flowed from the wellpad, into a drainage ditch adjacent the wellpad, through a catchment basin, into and through the vegetated wetland, and into a small segment of Stevens Creek where it was contained. Remediation response activities prevented significant impacts to Stevens Creek and subsequent flushing operations washed the material into a basin where it was diluted and pumped back to the wellpad where it was recovered, containerized, and transported for treatment.

Remediated Site media were evaluated for the following analytes:

**Surface Water:**

- Target Compound List (TCL) volatile organic compounds (VOCs) and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TCL semivolatile organics (SVOCs); and
- Target Analyte List (TAL) Metals (both filtered and unfiltered).

**Soil:**

- TCL VOCs and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TAL Metals; and
- TCL SVOCs.

The following analytes were detected at the Site:

**Surface Water:**

Aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

**Soil:**

Chloride, acetone, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenze, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc.

The selected remediation standards for demonstration of attainment to receive Relief from Further Remediation Liability Protection (ROL) is the Background Standard (BKGS) for lead and cobalt in Site soils and the Statewide Health Standard (SHS) residential, used aquifer (R-U) Medium-Specific Concentrations (MSCs), as specified in 25 PA Code Chapter 250.

Sampling to characterize Site conditions was conducted after completion of remedial response actions. Results indicate that these actions were effective in remediating impacted areas. Impacted areas were remediated and attainment of the BKGS for lead and cobalt in Site soils and SHS R-U MSCs were demonstrated for all other constituents of potential concern (COPCs) that are regulated constituents for both the drilling mud and frac fluid releases, including:

**Surface Water:**

Aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

**Soil:**

Chloride, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenze, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc.

Cabot is requesting Relief from Further Remediation Liability Protection from the PADEP for identified COPCs for the areas impacted by the drilling mud and the frac fluid releases that were remediated to meet the selected standards. Relief From Further Remediation Liability Protection is requested for Cabot, GDS (drilling and remediation contractor), the landowner

Ex. 6 - Personal Privacy

and all subsequent owners and operators of the remediated area in accordance with Pennsylvania's Land Recycling Act (Act 2) according to the regulatory requirements of 25 PA Code Chapter 250.

## 1.0 INTRODUCTION

This Final Report documents the cleanup efforts, estimated area impacted, and the results of site remediation related to a May 2009 drilling mud release in the vicinity of the Heitsman #2V well and three “frac fluid” releases that occurred during two separate events on September 16, 2009 and September 22, 2009 in the vicinity of Heitsman #4H well (co-located on the same well pad) located in Dimock Township, Susquehanna County, Pennsylvania (Wellsite). The land is currently owned by Ex. 6 - Personal Privacy and is leased by Cabot Oil & Gas Corporation (Cabot) to explore for and produce natural gas (**Figure 1**).

The Heitsman #2V/#4H Wellsite (**Figures 1** through **3**) was constructed according to an approved Erosion and Sedimentation (E&S) Control Plan dated November 7, 2007. The Wellsite was constructed on a gently west-sloping, wooded lowland, along the edge of an open hayfield with natural drainage through a wetland to Stevens Creek.

### 1.1 OBJECTIVES

In accordance with 25 PA Code Chapter 250, the objectives of the Remedial Investigation and Final Report are to:

- Provide sufficient physical data through field investigations to determine if a release has occurred and, if so, what constituents of potential concern (COPCs) are involved and the extent of migration, if any, of those COPCs into surface water, groundwater, or soil;
- Evaluate and define any source(s) of impact;
- Evaluate whether interim remedial actions are necessary to abate an imminent hazard to human health or the environment and describe the remedial actions conducted to minimize impact to the environment;
- Determine, from measurements at the Site, values for input parameters, including hydraulic conductivity, source dimensions, hydraulic gradient, and groundwater table fluctuations necessary for fate and transport analysis;
- Develop a Conceptual Site Model (CSM);
- Provide an evaluation of potential exposure pathways and potentially exposed populations;

- Provide sufficient information to draw conclusions regarding the attainment of the clean up standards selected and, if required, development of warranted remedial options for each medium of concern.

## 1.2 SCOPE OF WORK PERFORMED

Remedial activities were implemented to recover as much drilling mud and frac fluid as was feasible. The remediation effort recovered the majority of released mud and frac fluid within 48-hours of the releases.

Visual evaluation for drilling mud and frac fluid was conducted, and soil and surface water samples were collected to evaluate the effectiveness of remedial activities in the vicinity of the adjacent wetland and Stevens Creek. Background soil samples were collected in the area of the vegetated wetland and analyzed to evaluate background concentrations of metals in the vicinity of the Site.

Soil and surface water samples in the area that was impacted by the releases were collected, analyzed, and evaluated for attainment with Act 2 standards. The results indicated the cleanup attained compliance with the Background Standard (BKGS) for lead and cobalt in Site soils and the Statewide Health Standard (SHS) Residential, Used aquifer (R-U) Medium-Specific Concentrations (MSCs) for all other COPCs.

Once all documentation was assembled and evaluated, this Final Report was compiled to document Site conditions, demonstrate attainment compliance with SHS R-U MSCs for all COPCs for the drilling mud release and the frac fluid releases, and request Relief From Further Remediation Liability Protection (ROL) from the Pennsylvania Department of Environmental Protection (PADEP) for GasSearch Drilling Company (GDS), Cabot, the landowner (Anne Heitsman), and all subsequent owners and operators of the remediated area in accordance with Pennsylvania's Land Recycling Act (Act 2) and with the regulatory requirements of 25 PA Code Chapter 250. The Notice of Intent to Remediate (NIR) for the Wellsite and required public and municipal notifications are provided in **Appendix A**.

## 2.0 SITE DESCRIPTION

### 2.1 LOCATION

The Heitsman #2V/#4H Wellsite is part of an approximately 209 acre parcel consisting of a wooded/vegetated area and open farm field located adjacent to an existing farm road accessed from Troy Road (T-388) in Dimock Township, Susquehanna County, Pennsylvania (**Figure 1**). The parcel is leased by Cabot, from Ex. 6 - Personal Privacy for the exploration and production of natural gas. The Heitsman #2V/#4H Wellsite (**Figures 2** and **3**) was constructed according to an approved E & S Control Plan dated November 7, 2007. The Wellsite was constructed on a gently west-sloping, wooded lowland along the edge of an open hayfield. The Wellsite naturally drains through a vegetated wetland to Stevens Creek, a tributary to Meshoppen Creek (designated as Cold Water Fishery (CWF)).

The Wellsite was graded to slope gently to the west, covered with a geotextile, and overlain with about 1 foot (') thick layer of riprap to provide a working surface to construct the wells.

### 2.2 SITE HISTORY

About 7:30 PM on Wednesday May 6, 2009, during drilling activities at the Heitsman #2V well, a 6-inch hose on the outlet side of the mud pump failed. The released water-based mud flowed to a low point beside the well pad and toward the hay bales (E & S controls) protecting the adjacent wetland and Stevens Creek. The drilling mud breached the hay bale barrier by flowing under the hay bales and, subsequently, entered the wetland. The drilling mud is black in color; therefore, the extent of the area of impact could be easily determined visually (**Appendix B – Photographs 2** through **7**). **Figure 2** shows the area of impact.

There were three (3) distinct releases of frac fluid at the Heitsman #4H wellpad. Two releases occurred on September 16, 2009 and a third release occurred on September 22, 2009. All three releases were properly reported to PADEP. Details of the three releases have been documented elsewhere (URS, October 9, 2009 Engineering Study submitted to the PADEP in response to an Order dated September 24, 2009) and are summarized below. **Figure 4** shows the location of the three releases at the Heistman #4H Wellsite.

The initial release occurred on September 16, 2009 at about 1:45 PM shortly after contract personnel opened a lever-type valve on the discharge from a 21,000-gallon feed tank located on the Heitsman #4H wellpad (**Appendix B – Photograph 15**). The mechanical coupling on a suction hose at the valve on an adjacent tank became uncoupled and approximately 1,050-2,100 gallons of frac fluid (fresh water and gel mixed at the prescribed 1,000:5 ratio) was released over a period of about 2 minutes to the wellpad surface before the coupling could be reattached. The coupling did not appear to be damaged. It has not been definitely determined, but the fast-acting lever valves may have contributed to a pressure surge that may have been related to this coupling failure. A portion of the release drained from the wellpad to a forested wetland adjacent to the pad, and eventually reached Stevens Creek.

A second release of frac fluid occurred at approximately 8:00 PM on September 16, 2009. A Baker Corporation (water transfer contractor for Cabot) report of the event indicates that a 12-inch diameter mechanical coupling fitting in the water transfer piping upstream of the feed tank manifold failed on the main wellpad. As with the earlier release, the contained frac fluid was pumped to a container and the affected area was flushed with fresh water. Before fracing operations resumed, several mechanical connections were replaced with fused high density polyethylene (HDPE) pipe connections. In addition, mechanical hose connections were replaced with flanged connections wherever possible and several hand-wheel valves were added to replace lever-type valves. An extra valve was also added on every line between the suction manifold and the feed tanks on the wellpad to serve as an additional isolation valve.

A third release of frac fluid occurred at 6:30 AM on September 22, 2009. Approximately 420 gallons of diluted frac fluid (fresh water and gel at greater than the 1,000:5 rate used for fracing) was released onto the wellpad surface during fracing activities. The frac fluid was diluted because the frac job was being transitioned at this time from a water/gel mix to fresh water only in the water transfer system. According to the Cabot incident report, this release was caused by two 8" Kanaflex flexible polyvinyl chloride (PVC) hoses that failed due to a pressure surge that occurred during the seventh stage of the Heitsman #4H frac. The valves (which were added after the second release event described above) on both ends of the ruptured hoses were closed, preventing a larger release. All but approximately 10 gallons of the mixture was contained in the catchment basin at the base of the wellpad.

The frac fluid is a mixture consisting of fresh water and a proprietary liquid gel concentrate called LGC-35 CBM, or “frac gel” supplied by Halliburton (MSDS are included in **Appendix C**. Frac fluid is mixed at a ratio of 5 gallons of frac gel to 1,000 gallons of fresh water, resulting in a mixture that is 99.5 percent water and 0.5 percent frac gel.

The frac fluid releases at the Heitsman #4H location were caused by equipment failures resulting from pressure surges in the water transfer system. A factor contributing to the pressure surges is the elevation difference of approximately 240 feet between the frac tank farm where the water source was stored and the wellpad (**Figure 3**). The hydrostatic pressure resulting from this elevation difference combined with pressure fluctuations associated with fracing resulted in the pressure rating of some piping components being exceeded. Similar topographic conditions have not been encountered at other Cabot fracing locations.

## **2.3 REMEDIAL ACTIVITIES AND REMEDIAL INVESTIGATION ACTIVITIES**

Interim remedial actions and remedial investigation activities have been completed for all of the releases and are described in detail in the following sections.

### **2.3.1 HEITSMAN #2V MUD RELEASE**

An earthen dam was created near the outflow of the wetland at the discharge point to Stevens Creek by 8:30 PM on May 6, 2009 (about 1 hour after the release occurred) and thus, prevented drilling mud from impacting Stevens Creek (**Appendix B – Photographs 5 and 6**).

Once the earthen dam was in place, GDS, Cabot’s drilling contractor, initiated remediation of the impacted area, including pumping of drilling mud from the area within the E&S controls (estimated to be about 5,000 ft<sup>2</sup>) (**Appendix B – Photographs 7 through 10**), and the wetland (estimated to be about 6,000 ft<sup>2</sup>) (**Figure 2**). Drilling mud from within the E&S controls was pumped into the lined mud pit on the well pad using a GDS water truck.

A second dam was constructed to provide additional protection to Stevens Creek and also create a holding basin in the lower portion of the wetland (i.e. where the wetland normally would enter Stevens Creek). Drilling mud was flushed (using potable water) from the area where it had entered the wetland (under the hay bales) downward to the holding basin where it was

pumped up to the lined mud pit on the well pad for subsequent disposal along with other drilling fluids. Flushing potable water through the impacted wetland area was continuous from Wednesday May 6, 2009 at 8:30 pm until the morning of Tuesday May 12, 2009 at 7:00 AM – a period of about 130.5 hours. About 35,000 gallons of potable water was used to flush the drilling mud from the wetland to the holding area where it was subsequently pumped to the lined mud pit for eventual disposal (**Appendix B – Photographs 11 and 12**). This water was disposed at the Johnstown Regional Sewage Wastewater Treatment Plant located at 241 Asphalt Road, Johnstown, PA (**Appendix D**).

### 2.3.2 HEITSMAN #4H FRAC FLUID RELEASES

There were three (3) distinct releases of frac fluid at the Heitsman #4H wellpad. Two releases occurred on September 16, 2009 and a third release occurred on September 22, 2009 (as described in **Section 2.2**).

#### September 16, 2009 1:45 PM Release

Contractor cleanup crews constructed a hay bale and earth dam containment basin off the southeastern corner of the wellpad (**Figure 5**). A second temporary hay bale and earth dam system (consisting of two such earth and hay bale dams) was placed within Stevens Creek to prevent downstream migration of the released frac fluid (**Figure 5**). Cleanup crews then captured frac fluid to a container and flushed the affected area with fresh water. Before resuming operations, a detailed check was made that all connections were secure.

Due to the immediate response measures taken by on-site contractor personnel, a significant volume (approximately 800 gallons) of the release was isolated from reaching the adjacent wetland and creek. Therefore, about 1,300 gallons of frac fluid was released to the wetland and creek. It is estimated that less than 10 percent of this released material (130 gallons) reached the stream. The 1,300 gallons of frac fluid that entered the wetland contains about 6.5 gallons of frac gel having about 0.353 pounds of petroleum distillate constituents. The released material was reported to have been recovered during Site response actions over a continuous 26-hour time-period after the initial release. The recovered material was pumped to the wellpad and contained and subsequently transported to a treatment facility. Disposal documentation is provided in **Appendix E**.

### **September 16, 2009 8:00 PM Release**

As with the earlier release, the contained frac fluid was pumped to a container and the affected area was flushed with fresh water. Before fracing operations resumed, several mechanical connections were replaced with fused HDPE pipe connections. In addition, mechanical hose connections were replaced with flanged connections wherever possible and several hand-wheel valves were added to replace lever-type valves. An extra valve was also added on every line between the suction manifold and the feed tanks on the wellpad to serve as an additional isolation valve.

Surrounding valves were immediately closed, but the incident resulted in the release of approximately 5,880 gallons of frac fluid (fresh water and gel mixed at the prescribed 1,000:5 ratio) to the wellpad surface over a period of 10 minutes. With the temporary containment measures in place from the earlier release, an estimated minimum of 90 percent of the 8:00 PM release was contained and immediately recovered. Therefore, at most, approximately 588 gallons of frac fluid containing approximately 2.94 gallons of frac gel having 0.162 pounds of petroleum distillate constituents was released to the wetland area. The released material was reported to have been recovered during Site response actions over a continuous 26-hour time-period after the initial release, pumped to the wellpad, contained, and transported to a treatment facility. Disposal documentation is provided in **Appendix E**.

### **September 22, 2009 6:30 AM Release**

According to the Cabot incident report, this release was caused by two 8" Kanaflex flexible PVC hoses that failed due to a pressure surge that occurred during the seventh stage of the Heitsman #4H frac. The valves (which were added after the second release event described above) on both ends of the ruptured hoses were closed, preventing a larger release. All but approximately 10 gallons of the mixture was contained in the catchment basin at the base of the wellpad. The impacted area from this release did not exceed that of the earlier releases due to the temporary containment measures that had already been put in place (described above). The 10 gallons of diluted frac fluid contains a *de minimus* quantity frac gel and, therefore, a *de minimus* quantity of petroleum distillate constituents was released to the wetland.

### **3.0 GEOLOGIC AND HYDROGEOLOGIC SETTING**

#### **3.1 SITE SOILS/SURFICIAL GEOLOGY**

The soils underlying the Wellsite belong to the Volusia channelly silt loam. Based on published sources, the following soil series descriptions have been mapped at the Site:

The Heistman #2V/#4H Wellsite is underlain with the Volusia Series soil. The Volusia series consists of very deep, somewhat poorly drained soils formed in loamy till. These soils are on concave to planer landscape positions in glaciated upland areas. A dense fragipan is at a depth of 10 to 22 inches below the soil surface. Saturated hydraulic conductivity in the mineral soil above the fragipan is moderately high or high and in the fragipan and substratum it is low to moderately high.

Volusia soils occupy long uniform slopes. Slope ranges from 0 to 25 percent. They are on lower valley sides and on broad divides of maturely dissected glaciated plateaus. The Volusia soils developed in firm basal till derived from siltstone, sandstone and brittle shale or slate. They are underlain by lacustrine materials in some areas.

Volusia soils are typically 26 to 38 inches thick; dark grayish brown channery loam that is very firm to brittle having common fine pores with common faint dark grayish brown (2.5Y 4/2) clay films and silt coats on faces of prisms with about 30 percent rock fragments and many distinct large prominent yellowish brown masses of iron accumulation.

The B horizon is dominantly loam or silt loam in the fine-earth fraction but ranges to clay loam or silty clay loam. It has weak to strong coarse or very coarse prismatic structure with blocky, platy, subangular blocky, or massive prism interiors. Clay films coat most pore walls and can be in some depressions on vertical cleavage faces. Consistency is firm through extremely firm.

#### **3.2 SURFACE WATER**

The adjacent vegetated wetland (west of the Wellsite) was impacted by both the mud release and the frac fluid releases. In addition, Stevens Creek was impacted by the frac fluid release. Stevens Creek flows to the south and drains into Meshoppen Creek, a tributary of the Susquehanna River.

### 3.3 REGIONAL GEOLOGY

The Wellsite is located at approximately 1,280 ft amsl (above mean sea level) in the **Glaciated Low Plateau Section of the Appalachian Plateaus Province** physiographic province. The Glaciated Low Plateau Section includes an area of diversified topography in northeastern Pennsylvania. The topography consists of rounded hills and broad to narrow valleys all of which have been modified by glacial erosion and deposition. Swamps and peat bogs are common in the area. The area reflects the interplay between bedrock of various types, mainly sandstones and siltstones, and glacial erosion and deposition. The more erosion-resistant rocks form the hills, while the less erosion-resistant rocks occur in the valleys. Glacial deposits, mainly glacial till or sand and gravel, may occur anywhere, but are found mainly in the valley bottoms and margins (Sevon, 2000).

### 3.4 REGIONAL HYDROGEOLOGY

The local hydrogeology at the Wellsite is typical of the regional hydrogeology of the Low Glaciated Section of the Appalachian Plateau Physiographic Province (Socolow, 1980). The uppermost aquifer is typically unconfined and within unconsolidated glacial till. The till in this area is typically more discontinuous than in the northwestern portion of the state. Some of these soils have a fragipan at shallow depth and therefore are somewhat poorly drained. The surface texture of these soils is predominantly silt loam. The landscape is undulating and the erosion potential is low to moderate. Rock fragments are common in the soils of this area. Some of the soils have very low root zone available water-holding capacity due to their limited rooting depth. The growing season is short due to the elevation and northern latitude.

#### **4.0 SELECTION OF CONSTITUENTS OF POTENTIAL CONCERN AND SELECTION OF REMEDIATION STANDARDS**

Based on the observed release of drilling mud and frac fluid and the results of the remedial investigation, COPCs at the Site are evaluated and defined (TGM, 2002) as follows. Site media were evaluated for the following analytes:

##### **Surface Water:**

- Target Compound List (TCL) volatile organic compounds (VOCs) and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TCL semivolatile organics (SVOCs); and
- Target Analyte List (TAL) Metals (both filtered and unfiltered).

##### **Soil:**

- TCL VOCs and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TAL Metals; and
- TCL SVOCs.

The following analytes were detected at the Site:

##### **Surface Water:**

Aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

##### **Soil:**

Chloride, acetone, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenzene, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc.

The selected remediation standards for demonstration of attainment to receive ROL are the BKGS for lead and cobalt in Site soils and is the SHS R-U MSCs for all other COPCs, as specified in 25 PA Code Chapter 250.

**Table 1** summarizes the surface water results for the sampling for the remedial investigation after the mud release at the Heitsman #2V Wellsite. **Table 2** summarizes the surface water results for samples collected after both the May 6, 2009 mud release and the Heitsman #4H frac fluid releases. **Table 3a** summarizes the soil sample (solid fraction) results after the September 16, 2009 Heitsman #4H frac fluid release. **Table 3b** summarizes the soil sample (liquid fraction) results after the September 16, 2009 Heitsman #4H frac fluid release. **Table 4** summarizes the results for VOCs and SVOCs for surface water and soil samples after both the May 6, 2009 mud release and the September 2009 frac fluid releases had been remediated. **Table 5** summarizes the results for TAL Metals for soil samples after both the May 6, 2009 mud release and the September 2009 frac fluid releases had been remediated. **Table 6** summarizes the results for the Synthetic Precipitation Leaching Procedure (SPLP) for selected metals in selected confirmational soil samples in the vicinity of the Site. **Table 7** summarizes the results for TAL Metals for soils from background (soils not impacted by either the mud release or the frac fluid release) areas in the vicinity of the Site.

Post-remediation confirmational sampling demonstrates attainment of the BKGS for lead and cobalt in Site soils and the SHS R-U MSCs for all other Site COPCs.

## 5.0 REMEDIAL INVESTIGATION, SITE REMEDIATION AND CONFIRMATIONAL SAMPLING

URS provided oversight and confirmational sampling for remediations following the mud release on May 6, 2009 and the frac fluid releases on September 16 and 22, 2009 as detailed below.

### 5.1 Heitsman #2V Mud Release

URS observed the progress of the remediation efforts on May 11, 2009 and inspected the area again on May 12, 2009. At that time, based on visual observations, the impacted area was determined to have been successfully remediated.

Mike O'Donnell of the PADEP had visited the Wellsite on the morning of May 11, 2009 to inspect progress on site remediation. On the morning of May 12, 2009, URS and GDS contacted Mike O'Donnell by telephone to determine requirements to demonstrate that the Site has been remediated to the satisfaction of PADEP. The result of that conversation was two-fold:

- a thorough visual inspection should be performed and documented; and
- surface water samples should be collected from Stevens Creek and submitted to an analytical laboratory for analysis.

Therefore, URS recorded site conditions by visually inspecting and photographing the area following remediation. These conditions were then compared to photos taken prior to remediation (i.e. immediately following the drilling mud release). Thus, a “before-and-after” visual evaluation was conducted, providing evidence that the remediation was successful.

**Appendix B – Photographs 1** through **6** document impacts and **Photographs 10** and **11** document conditions after remediation.

As part of the documentation of site conditions requested by PADEP, URS also conducted a visual evaluation and comparison of a segment of Stevens Creek both up and downstream from the area where the wetland had been impacted by the drilling mud (**Appendix B – Photographs 13** and **14**). Inspection indicated there were no visual impacts to the bed of Stevens Creek.

Surface water was also collected from an area downstream and an area upstream of the normal outflow from the wetland to evaluate potential impact. Analytical results associated with the surface water samples are summarized in **Table 1** and the full analytical data package is provided in **Appendix F**. The analytical results indicate that remediation efforts at the Wellsite have prevented impact to Stevens Creek. Furthermore, general water quality parameters are essentially identical both upstream and downstream of the wetland entryway to Stevens Creek.

## 5.2 Heitsman #4H Frac Fluid Releases

URS conducted a detailed visual evaluation and created a sketch map of the affected area on September 22, 2009 after the remediation effort had been completed. The area evaluated extended along the pathway of frac fluid migration from the wellpad, through the drainage swale along the south side of the wellpad, through the catchment basin, into and through the wetland, and into Stevens Creek (**Figure 5** and **Appendix B – Photographs 15 through 34**). No visible frac fluid (white, milky liquid) was observed to be present in any area of the wetland or in Stevens Creek after remediation.

On September 17, 2009, Quantum Analytical and Environmental Laboratories, Inc. (Quantum) sampled and analyzed two surface water samples collected from Stevens Creek (#3 and #4), a sample of the water in a catchment basin off of the corner of the wellpad (#1), and a sludge sample (#2) from the corner of the wellpad (**Figure 6**).

URS sampled eight surface soil locations (0 to 6 inches below ground surface) on September 22, 2009 after the remediation effort had been completed. The remediation consisted of a fresh water flush over a continuous 26 hour period from the time of the first release. Fresh water was flushed from the top of the wellpad, through the affected area of the wetland, and into Stevens Creek and then captured and pumped back up to the wellpad for storage and subsequent disposal. Eight confirmational samples were taken to evaluate the effectiveness of remediation activities. Sampled locations (**Figure 7**) included: a downgradient sample from Stevens Creek (H-1), a sample of sediment at the outflow of the wetland into Stevens Creek (H-2), upgradient sample from Stevens Creek (H-3), three samples of soil in the wetland along the pathway of migration (H-4, H-5, and H-6), a sample of sediment in the catchment basin (H-7), and a sample in the drainage ditch adjacent the Baker tanks where the frac fluid in all three releases initially left the wellpad (H-8). Sediment and soil samples were analyzed for VOCs and SVOCs.

URS conducted additional sampling after subsequent discussions with PADEP regarding the sampling conducted on September 22, 2009, including:

- Four additional samples of surface water from Stevens Creek on November 18, 2009, including two samples downgradient of the wetland drainage inlet to Stevens Creek (SC-D1 and SC-D2) and two samples upgradient of the wetland drainage inlet to Stevens Creek (SC-U1 and SC-U2) (**Figure 7**)
- Five additional confirmational surface soil locations (0 to 6 inches below ground surface) on November 18, 2009 (H-8A, H-10, H-11, and H-12 – **Figure 7**), including:
  - Three additional samples in the central portion of the wetland (H-10, H-11, and H-12):
  - One sample in the drainage ditch adjacent the Baker tanks where the frac fluid in all three releases initially left the wellpad (H-8A) in the same location as H-8, collected on September 22, 2009; and
  - One sample near the edge of the wellpad in the area near where the second release occurred (H-13).

A meeting was held with the PADEP on November 19, 2009 to discuss the results to date, present the locations of the additional samples collected, and finalize sampling and analysis to characterize the Site to evaluate for residual impacts and demonstrate attainment with Act 2 requirements. As a result of the meeting, PADEP concurred with the sampling plan; however, they requested an additional sample of the surface water be collected in the central portion of the wetland that had been impacted by the drilling mud and frac fluid releases. URS collected this sample (HWL-1) and an additional sample (HWL-2) from a wetland that had not been impacted by the releases of drilling mud and frac fluid at a location across Stevens Creek (**Figure 7**) to compare results to a wetland that had not been impacted by the drilling mud and the frac fluid. Laboratory reports for the samples collected by URS (samples collected on September 22, 2009 and November 18 and 19, 2009) are included in **Appendix F**. Data are summarized in **Tables 2, 3a, 3b, and 4**.

The four additional samples of surface water from Stevens Creek were collected and analyzed to evaluate for potential residual impacts from the frac fluid release. These data are summarized on **Table 2** for comparison with data for samples collected by Quantum on September 17, 2009.

On March 10, 2010, several sampling locations were resampled to evaluate for concentrations of TAL Metals. These locations consisted of areas that had been impacted by the May 6, 2010 release of drilling mud and the September 2009 releases of frac fluid, and included seven surface soil locations (0 to 6 inches below ground surface - H4R, H5R, H10R, H11R, H12R, H13, and H14 – **Figure 7**). Laboratory reports for the samples collected by URS (samples collected on March 10, 2010) are included in **Appendix F**. Data are summarized in **Table 5**.

On April 27, 2010 several additional sampling locations were sampled to evaluate for concentrations of TAL Metals. These locations included 3 additional locations in the area impacted by drilling mud that were remediated (H-15, H-16, and H-17), and 10 locations that were not impacted by either the drilling mud or the frac fluid (background locations - BG-1 – BG-10) – **Figure 7**). Laboratory reports for the samples collected by URS (samples collected on April 27, 2010) are included in **Appendix F**. Data are summarized in **Tables 5, 6, and 7**.

### Results for Soil/Sediment

Methyl-Ethyl Ketone (MEK), (2-butanone), sec-butylbenzene, n-butylbenzene, ethylbenzene, naphthalene, toluene, p-isopropyltoluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and total xylenes were detected in the confirmational samples (**Table 4**) and the results were compared to the Act 2 SHS R-U MSCs. The sample from the drainage ditch along the edge of the well pad (H-8) collected on September 22, 2009 exceeded the respective SHS R-U MSCs for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene when considered as a saturated soil sample (for saturated soil, the MSC is 1/10 the unsaturated soil MSC). However, when the same area was sampled on November 18, 2009 (H-8A), the drainage ditch soil was not saturated and no COPCs were detected in the sample.

The solid fraction of the sludge from the mud pump at the corner of the well pad had no exceedances of either direct contact or soil to groundwater, SHS R-U MSCs. The liquid fraction of sludge collected from the mud pump area at the corner of the well pad had elevated chloride concentrations in the liquid portion of the sample.

Aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc were detected in the confirmational samples collected to evaluate for potential residual impact from drilling mud (**Table 5**) and the results were compared to Act 2 SHS R-U MSCs.

Attainment of the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs in Site media impacted by the released drilling mud and released frac fluid (**Section 10.0**) document that Site remediation had effectively remediated the area to either background or residential standards.

### **Results for Surface Water from Wetlands**

URS collected a sample of the surface water in the central portion of the wetland (**Figure 6**) on November 19, 2009, as requested by PADEP to evaluate for residual impacts and document the effectiveness of remedial measures implemented. An additional sample from a wetland that had not been impacted by either the release of drilling mud or the release of frac fluid was collected at a location across Stevens Creek (**Figure 6**) to compare results. The results are presented in **Table 2**. No VOCs or SVOCs constituents were detected and no exceedances of surface water quality criteria were observed for either the wetland that had been impacted or the wetland across Stevens Creek. This documents that remediation activities implemented by Cabot were effective in removing impacts from the wetland area.

### **Results for Stevens Creek Samples**

Surface water samples collected on September 17, 2009 were analyzed on an unfiltered basis for selected water quality parameters, including total dissolved solids (TDS), total suspended solids (TSS), chloride, Metals, VOCs, and SVOCs content. VOCs were not detected at or above the reporting limit for samples from the upgradient location in Stevens Creek. SVOCs were not detected at or above the reporting limit for both upgradient and downgradient samples from Stevens Creek. The unfiltered sample downgradient of the inlet from the impacted wetland contained metals (total metals – the sample was not filtered) and low levels of 1,2,4-trimethylbenzene (34 ug/L), 1,3,5-trimethylbenzene (12.4 ug/L), acetone (139 ug/L - possible laboratory contaminant), and chloride. These constituents and p-isopropyltoluene and m,p-xylenes were detected in water collected from the catchment basin at the edge of the well pad that received frac fluid from the release. None of the organic constituents exceeded established surface water quality criteria (**Table 2**). Observed concentrations for arsenic, copper, iron, and lead are likely due to the fact that the samples were unfiltered and possibly included sediment from the bed of Stevens Creek.

Subsequent sampling of Stevens Creek on November 18, 2009 at locations both upgradient and downgradient of the inlet from the wetland that had been impacted indicated no exceedances of

established water quality criteria and no VOCs, indicating no residual impacts from the releases (**Table 2**).

Groundwater beneath the Site is not a medium of concern because the drilling mud and frac fluid migration occurred by gravity flow downhill at the surface, coupled with immediate remedial response, provided no opportunity for these materials to infiltrate to groundwater.

## 6.0 FATE AND TRANSPORT ANALYSIS

Both the drilling mud and frac fluid releases initially flowed onto the constructed well pad where impacts were limited to the surficial materials above the geotextile. Drilling mud migrated off the well pad along the southern edge of the pad and into the vegetated wetland area west of the well pad. The released frac fluid migrated off the well pad, along the drainage ditch south of the well pad, flowed down the hillside of the constructed well pad, onto the ground surface, and into the vegetated wetland to the west of the E & S controls. The drilling mud release did not reach Stevens Creek, due to rapid response by GDS. The initial frac fluid release reached Stevens Creek, however, rapid response by GDS prevented downstream migration of the material.

For these reasons, both drilling mud and frac fluid migration was limited to gravity flow over the surface of the impacted area, with minimal infiltration anticipated. Flushing the released material from the elevated portion of the well pad to the vegetated wetland, with subsequent recovery of the flushed material to the well pad pit and tank trucks, effected remediation of the Wellsite impacted areas.

URS has determined that no residual impacts to Stevens Creek are present based on the analytical results for both sediment samples and surface water samples taken from the area potentially impacted in Stevens Creek. All areas impacted by both the drilling mud and frac fluid releases have been remediated to achieve attainment with the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs in Site media impacted.

## 7.0 SITE CONCEPTUAL MODEL

Based upon the data acquired during the Remedial Investigation activities, surface soils in the vicinity of the well pad and adjacent vegetated wetland, as well as sediment from the bed of Stevens Creek and surface water from both the adjacent wetland area and Stevens Creek were found to be minimally impacted in areas where the drilling mud and frac fluid releases occurred. The nature and extent of the releases were evaluated using the pathways of migration observed by Site personnel at the time of the releases. Rapid response did not allow penetration of drilling mud and frac fluid to depths greater than about 0-2 inches bgs in the areas impacted by the release.

Based on soil and sediment sampling results, soil impact has been delineated both vertically and horizontally at the Wellsite. Groundwater was not expected to be impacted. The release of the drilling mud and frac fluid from the well pad associated with drilling operations, and subsequent flow of both the drilling mud and frac fluid downhill to the vegetated wetland toward Stevens Creek impacted a relatively narrow pathway of migration that was limited to the surface and near-surface soils (0 – 6” bgs) and standing water present in the vegetated wetland adjacent the well pad, and a small portion of Stevens Creek.

Soil, sediment, and surface water samples and two rounds of surface water samples were collected throughout the Remedial Investigation and demonstration of attainment activities (**Figures 6, 7 and 8 and Tables 1, 2, 3a, 3b, 4, 5 and 6**).

Remedial activities have remediated Site media (soil and surface water) so that attainment with the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs in Site media has been demonstrated (**Section 10.0**).

## 8.0 ECOLOGICAL SCREENING ASSESSMENT

In accordance with 25 PA Code §250.311 and the PADEP TGM (2002), an evaluation of potential impact to ecological receptors from Site conditions was completed utilizing the Ecological Screening Process. No additional evaluation was conducted since the following criteria were met at the Site:

- The area of soil having residual impacts is less than 2 acres and the area of sediments having residual impacts is less than 1,000 square feet. (25 PA Code §250.311(b)(2).

Therefore, no additional evaluation is required.

## 9.0 SELECTION OF REMEDIATION STANDARDS

Based on the findings of the Site characterization as described above, Cabot has elected to seek ROL by demonstrating attainment of the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs in Site media. Soil, sediments, and surface water were the only media impacted by the drilling mud and frac fluid releases. Remediation of surface water, soil and sediments was conducted to meet the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs in Site media.

Surface water was remediated to meet SHS R-U MSCs and Ambient Water Quality Criteria (25 PA Code Chapter 16) as indicated in **Table 2**.

Soils and sediments were remediated to meet the BKGS for lead and cobalt in Site soils and attainment of the respective SHS R-U MSCs for all other COPCs as indicated in **Tables 3a, 3b, 4, 5 and 6**.

## 10.0 ATTAINMENT DEMONSTRATION

This section presents the attainment demonstration of the SHS R-U MSCs for all COPCs in potentially impacted media sampled and analyzed after completion of remediation.

### 10.1 SOIL

Based on soil sampling results, soil impacts have been delineated both vertically and horizontally at the Site. In accordance with 25 PA Code §250.703, for statistical methods under §250.707(b)(1)(i), 75% of all samples are equal to or less than the SHS R-U MSCs or the limit related to practical quantitation limits (PQLs) with no individual sample exceeding 10x the SHS R-U MSC on the impacted and remediated area for all COPCS, with the exception of barium, lead, and cobalt in Site soils (**Tables 3a, 3b, 4 and 5**).

The Synthetic Precipitation Leaching Procedure (SPLP) was conducted on selected soil samples for metals to evaluate for concentration of metals in soils that would not produce a leachate in excess of the SHS R-U MSC for that constituent (25 PA Code Chapter 250.308(a)). The highest concentration of barium observed in the confirmational soil samples was 3,040 mg/kg detected in H10R. This concentration did not yield a leachate in excess of the SHS R-U MSC for barium; therefore, the attainment of the SHS R-U MSC is demonstrated.

As discussed previously, a total of 10 background samples were collected from outside the impacted area in the vegetated wetland on April 27, 2010. Background samples were collected within the top 0 – 6 " bgs of soil to coincide with the horizon of the soils sampled subsequent to remediation activities. Values in the background data set (**Table 7**) for cobalt ranged from ND <1.0 mg/kg (BG-1 and BG-2) to 10.9 mg/kg (BG-10). Values in the background data set (**Table 7**) for lead ranged from 7.1 mg/kg (BG-6) to 59.0 mg/kg (BG-3). Sample locations are presented on **Figure 7**.

Consistent with PADEP protocol, this approach was acceptable for establishing background conditions for cobalt and lead that is ubiquitous for the area. Consistent with the PADEP guidance, background tests were performed to statistically evaluate if the confirmation sample population was within that expected based on the background sample population and thus ensuring that soils were indicative of background (areas not impacted by the releases of drilling

mud and frac fluid) conditions. In accordance with 25 Pa Code §250.707(a)(1)(ii) the data populations were compared using the Wilcoxon-Mann-Whitney Ranked-Sum and Quantile tests for data from two populations. These are both non-parametric tests independent of population distribution. The confidence level for both tests ( $1-\alpha$ ) was set to 0.95 thereby meeting the false positive criteria ( $\alpha = 0.05$ ) under 25 Pa Code §250.707(a)(1)(iv) and 25 Pa Code §250.707(d)(2)(vii) for residential use. Note that for the quantile test, while the confidence level ( $1-\alpha$ ) was set to 0.95, the actual test conditions result in an  $\alpha$  of 0.043 for both lead and cobalt.

Non-detect values were not present for lead and the statistical tests were able to be run without censoring the data. For cobalt, non-detect values were present in both the background (BG-1 and BG-2) and site confirmation samples (H5R and H14). As a result, for the quantile test data were censored to discard all non-detect values present in the largest detected observations. For the Wilcoxon-Mann-Whitney Ranked-Sum test, data were censored by assigning the highest non-detect value for each population to each non-detect value. For example, in the background data set, where the non-detect values were <1.2 mg/kg (Bkg-1) and <1.0 mg/kg (Bkg-2), both values were assigned the higher value of 1.2 mg/kg. Additionally any positive detects below the highest detection limit were treated as non-detects and received the same average rank under this test. As presented in the User' Manual for ProUCL (USEPA, 2007), when a large number of non-detects or multiple detection limits are present the Gehan test is recommended to test populations containing 10 or more discrete data points. Consequently, as the confirmational and background populations met this criteria, the Gehan test was performed to confirm the results of the quantile and Wilcoxon-Mann-Whitney Ranked-Sum test for cobalt.

In order to perform the statistical tests, the USEPA's statistical software package ProUCL 4.0 was used (USEPA, 2007). Details of statistical calculations are provided in **Appendix E**. For both the quantile and Wilcoxon-Mann-Whitney tests for lead and cobalt, the null hypothesis ( $H_0$ ) was not rejected (i.e., samples from the Site area of concern have concentrations of lead and cobalt that are less than or equal to the background concentrations observed for lead and cobalt) and it can be assumed that the remaining soils in the remediated area meet the background conditions and demonstrate attainment under the background standard. For cobalt, the Gehan test supported the results of the quantile and Wilcoxon-Mann-Whitney tests and the null hypothesis ( $H_0$ ) was not rejected.

Results indicate that these actions were effective in remediating impacted areas. Impacted areas were remediated and attainment of the BKGS for lead and cobalt in Site soils and SHS R-U MSCs were demonstrated for all other COPCs that are regulated constituents for both the drilling mud and frac fluid releases in soil, including chloride, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenzene, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, iron, magnesium, manganese, nickel, selenium, vanadium, and zinc.

## 10.2 GROUNDWATER

Due to the rapid response of GDS in remediating both the drilling mud and frac fluid releases, short time-frame of exposure to these constituents, low conductivity of surface soils, and minimal anticipated depth of penetration of constituents, groundwater is not considered to be a medium of concern.

## 10.3 SURFACE WATER

Due to the rapid response of GDS in remediating the releases and short time-frame of exposure to COPCs, surface water has been shown not to have residual impacts and meets applicable water quality criteria (**Table 2**).

Results indicate that these actions were effective in remediating impacted areas. Impacted areas were remediated and attainment of the BKGS SHS R-U MSCs were demonstrated for all other COPCs that are regulated constituents for both the drilling mud and frac fluid releases in surface water, including aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

## 10.4 VAPOR INTRUSION

The potential effect of volatilization to indoor air quality (IAQ) was assessed using *Pennsylvania's Vapor Intrusion Into Buildings From Groundwater and Soil under Pennsylvania (PA) Act 2 SWHS Guidance* (January 24, 2004). This guidance document provides a screening methodology for evaluating the potential health effects resulting from vapor intrusion of

Chemicals of Potential Indoor Air Concern (COPIACs) using the Johnson and Ettinger (JE) Vapor Intrusion Model using PA-specific parameters (PADEP, 2004).

The JE-PA Guidance for vapor intrusion from soil indicates that there is no potentially complete exposure pathway due to the fact that there are no inhabitable structures within 100 feet of the area that may contain residual impacts at low levels. In addition, the presence of the producing gas well and associated equipment make the likelihood of inhabited structures in this area unlikely for the foreseeable future.

#### **10.5 POST REMEDIATION CARE PLAN**

No Post Remediation Care is required to attain and maintain attainment with the demonstration of attainment with the SHS R-U MSCs.

## **11.0 ENVIRONMENTAL COVENANT**

An Environmental Covenant is not required for this Site.

## 12.0 CONCLUSIONS

Cabot operates the leased Wellsite designated as Heitsman #2V and Heitsman #4H in Dimock Township, Susquehanna County, Pennsylvania (Wellsite). The Wellsite is a portion of a larger tract that consists of approximately 209 acres and is leased from Ex. 6 - Personal Privacy to explore for and produce natural gas.

During various drilling operations to install the Heitsman #2V and Heitsman #4H wells (co-located on the same well pad), four separate releases occurred: a drilling mud release in the vicinity of the Heitsman #2V well on May 6, 2009 and three “frac fluid” releases that occurred on September 16, 2009 (two releases) and September 22, 2009 (one release) in the vicinity of Heitsman #4H well.

The May 6, 2009 drilling mud release consisted of water-based mud that flowed to a low point beside the well pad and toward the hay bales (E& Scontrols) protecting a nearby wetland and Stevens Creek. The drilling mud release was properly reported to the PADEP. The drilling mud breached the hay bale barrier by flowing under the hay bales and, subsequently, entered the wetland. The drilling mud is black in color; therefore, the extent of the area of impact could be easily determined visually. The drilling crew was able to create an earthen dam at the outflow of the wetland where the wetland would normally have entered Stevens Creek and thus, prevented drilling mud from impacting Stevens Creek. The drilling mud was subsequently flushed from the wetland back up to the well pad and disposed of properly.

There were three (3) distinct releases of frac fluid at the Heitsman #4H wellpad. Two releases occurred on September 16, 2009 and a third release occurred on September 22, 2009. All three frac fluid releases were properly reported to the PADEP.

The frac fluid is a mixture consisting of fresh water and a proprietary liquid gel concentrate called LGC-35 CBM, or “frac gel” supplied by Halliburton that is mixed at a ratio of 5 gallons of frac gel to 1,000 gallons of fresh water, resulting in a mixture that is 99.5 percent water and 0.5 percent frac gel.

The frac fluid releases at the Heitsman #4H location were caused by equipment failures resulting from pressure surges in the water transfer system. A factor contributing to the

pressure surges is the elevation difference of approximately 240 feet between the frac tank farm where the water source was stored and the wellpad. The hydrostatic pressure resulting from this elevation difference combined with pressure fluctuations associated with fracing resulted in the pressure rating of some piping components being exceeded. Similar topographic conditions have not been encountered at other Cabot fracing locations.

Frac fluid released on September 16, 2009 flowed from the wellpad, into a drainage ditch adjacent the wellpad, through a catchment basin, into and through the vegetated wetland, and into a small segment of Stevens Creek where it was contained. Remediation response activities prevented significant impacts to Stevens Creek and subsequent flushing operations washed the material into a basin where it was diluted and pumped back to the wellpad where it was recovered, containerized, and transported for treatment.

Site media were evaluated for the following analytes:

**Surface Water:**

- TCL VOCs and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TCL SVOCs; and
- TAL Metals (both filtered and unfiltered).

**Soil:**

- TCL VOCs and VOCs determined to be present in the frac gel used to prepare the frac fluid (n-propylbenzene, n-butylbenzene, 4-isopropyltoluene, sec-butylbenzene, and isopropylbenzene);
- TAL Metals; and
- TCL SVOCs.

The following analytes were detected at the Site:

**Surface Water:**

Aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

**Soil:**

Chloride, acetone, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenze, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc.

The selected remediation standards for demonstration of attainment to receive Relief from Further Remediation Liability Protection (ROL) is the Background Standard (BKGS) for lead and cobalt in Site soils and the Statewide Health Standard (SHS) residential, used aquifer (R-U) Medium-Specific Concentrations (MSCs), as specified in 25 PA Code Chapter 250.

Sampling to characterize Site conditions was conducted after completion of remedial response actions. Results indicate that these actions were effective in remediating impacted areas. Impacted areas were remediated and attainment of the BKGS for lead and cobalt in Site soils and SHS R-U MSCs were demonstrated for all other constituents of potential concern (COPCs) that are regulated constituents for both the drilling mud and frac fluid releases, including:

**Surface Water:**

Aluminum, arsenic, barium, boron, calcium, copper, iron, magnesium, manganese, potassium, sodium, zinc, chloride, sulfate, and nitrate.

**Soil:**

Chloride, cumene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, methyl ethyl ketone (MEK), sec-butylbenze, n-butylbenzene, naphthalene, p-isopropyltoluene, toluene, total xylenes, aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc.

Cabot is requesting Relief from Further Remediation Liability Protection from the PADEP for identified COPCs for the areas impacted by the drilling mud and the frac fluid releases that were remediated to meet the selected standards (**Figure 8**). Relief From Further Remediation Liability Protection is requested for Cabot, GDS (drilling and remediation contractor), the landowner Ex. 6 - Personal Privacy and all subsequent owners and operators of the remediated area in accordance with Pennsylvania's Land Recycling Act (Act 2) according to the regulatory requirements of 25 PA Code Chapter 250.

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## TABLES

**Table 1**  
**Analytical Results**  
**Stevens Creek Samples May 12, 2009**  
**Heitsman #2V Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	UNITS	Heit-UP (Upstream Sample - Background)	Heit-DOWN (Downstream Sample)
Aluminum (total)	µg/L	71.7	74.5
Antimony (total)	µg/L	ND (5.0) <sup>1</sup>	ND (5.0)
Arsenic (total)	µg/L	ND (5.0)	ND (5.0)
Barium (total)	µg/L	32.8	34.1
Beryllium (total)	µg/L	ND (1.0)	ND (1.0)
Boron (total)	µg/L	ND (50.0)	ND (50.0)
Cadmium (total)	µg/L	ND (1.0)	ND (1.0)
Calcium (total)	µg/L	15,000	15,000
Chromium (total)	µg/L	ND (5.0)	ND (5.0)
Cobalt (total)	µg/L	ND (5.0)	ND (5.0)
Copper (total)	µg/L	ND (5.0)	ND (5.0)
Iron (total)	µg/L	242	236
Lead (total)	µg/L	ND (2.0)	ND (2.0)
Magnesium (total)	µg/L	3,630	3,620
Manganese (total)	µg/L	77.6	75.5
Molybdenum (total)	µg/L	ND (10.0)	ND (10.0)
Nickel (total)	µg/L	ND (10.0)	ND (10.0)
Potassium (total)	µg/L	2,480	2,480
Selenium (total)	µg/L	ND (5.0)	ND (5.0)
Silver (total)	µg/L	ND (1.0)	ND (1.0)
Sodium (total)	µg/L	17,900	17,900
Thallium (total)	µg/L	ND (10.0)	ND (10.0)
Vanadium (total)	µg/L	ND (5.0)	ND (5.0)
Zinc (total)	µg/L	ND (10.0)	ND (10.0)
Mercury (total)	µg/L	ND (0.20)	ND (0.20)
Alkalinity	mg/L	33.8	32.6
Total Dissolved Solids	mg/L	124	132
Total Suspended Solids	mg/L	ND (4.0)	ND (4.0)
Fluoride	mg/L	ND (0.10)	ND (0.10)
Chloride	mg/L	35.1	35.1
Total Phosphorus	mg/L	ND (0.030)	ND (0.030)
Sulfate Water	mg/L	12.1	12.0
Nitrate as N	mg/L	0.49	0.47

**Notes:**

<sup>1</sup> = ND (5.0) = Parameter not detected above reporting limit in parentheses.

**Table 2**  
**Analytical Results**  
**Surface Water**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>		
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland		Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria
Sample Date		9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
<b>Metals<sup>1</sup></b>													
Aluminum	ug/L	910	11,600	65,000	50.3	ND (50.0)	ND (50.0)	ND (50.0)	88.4	93.7	NS	NS	NS
Antimony	ug/L	NA	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	220	1,100	5.8
Arsenic	ug/L	12	14	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	150	340	10
Barium	ug/L	830	310	49	57.0	47.1	46.1	47.2	161	54.4	4,100	21,000	2,400
Beryllium	ug/L	ND (1.0) <sup>2</sup>	1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
Boron	ug/L	800	130	ND (50.0)	ND (50.0)	ND (50.0)	ND (50.0)	ND (50.0)	263	ND (50.0)	1,600	8,100	3,100
Cadmium	ug/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	0.25	2.0	NS
Calcium	ug/L	59,300	31,100	17,200	13,500	12,400	12,800	13,200	13,300	5,450	NS	NS	NS
Chromium <sup>1</sup>	ug/L	5.4	9.8	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	74.1	569.8	NS
Cobalt	ug/L	ND (5.0)	5.7	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	19	95	NS
Copper	ug/L	28	9.5	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	6.7	ND (5.0)	9.0	9.0	NS <sup>4</sup>
Iron	ug/L	1100	10,200	950	122	153	83.8	149	953	291	NS	NS	1,500
Lead	ug/L	3.5	9.7	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	2.52	64.58	NS
Lithium	ug/L	370	350	ND (50.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Magnesium	ug/L	9,600	900	4,100	3,500	3,240	3,350	3,460	3,710	1,250	NS	NS	NS
Manganese	ug/L	390	1,300	1,200	113	121	111	130	868	39.2	NS	NS	1,000 <sup>5</sup>
Molybdenum	ug/L	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	NS	NS	NS
Nickel	ug/L	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	52.0	468.2	610
Potassium	ug/L	11,000	25,300	6,300	3,210	3,020	3,200	3,300	2,000	978	NS	NS	NS
Selenium	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	4.6	NS	NS
Silver	ug/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	3.2	NS
Sodium	ug/L	133,000	110,000	18,100	12,900	12,000	12,600	13,000	11,600	2,180	NS	NS	NS
Strontium	ug/L	870	380	54	NA	NA	NA	NA	NA	NA	NS	NS	NS
Thallium	ug/L	NA	NA	NA	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	13	65	0.24
Vanadium	ug/L	NA	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NS	NS	NS
Zinc	ug/L	170	38	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	15.1	ND (10.0)	118.1	117.2	NS
Mercury	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.77	1.4	0.05

Table 2  
Analytical Results  
Surface Water  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>		
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland		Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria
Sample Date		9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
<b>Volatile Organic Compounds</b>													
Dichlorodifluoromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,1,1,2-Tetrachloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,1,2-Trichlorotrifluoroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,1-Dichloropropene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,2,3-Trichlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,2,4-Trimethylbenzene	ug/L	210	34.0	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
1,2-Dibromo-3-chloropropane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,2-Dibromoethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,3,5-Trimethylbenzene	ug/L	73.1	12.4	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
1,3-Dichloropropane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,2-Dichloropropane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2-Chloroethyl vinyl ether	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	3,500	18,000	NS
2-Nitropropane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
4-Chlorotoluene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Acrylonitrile	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	130	650	0.051
Allyl Chloride	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Bromobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Chloride	ug/L	226	209	36.1	NA	NA	NA	NA	NA	NA	NS	NS	NS
Chloroacetonitrile	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Chloroprene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
cis-1,4-Dichloro-2-Butene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Acetone	ug/L	501	139	ND (25.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	86,000	450,000	3,500
Benzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	130	640	1.2
Bromochloromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
Bromodichloromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	0.55
Bromoform	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	370	1,800	4.3
Bromomethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	110	550	47
2-Butanone (MEK)	ug/L	ND (25.0)	ND (25.0)	ND (25.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	32,000	230,000	21,000
n-Butylbenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
sec-Butylbenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
Carbon Disulfide	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS
Carbon tetrachloride	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	560	2,800	0.23
Chlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	240	1,200	130

Table 2  
Analytical Results  
Surface Water  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>			
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland		Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria	
		Sample Date	9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
Volatile Organic Compounds														
Chloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
Chloroform	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	390	1,900	5.7	
Chloromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	1.3	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	5,500	28,000	NS	
Dibromochloromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	0.4	
1,2-Dichlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,3-Dichlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,4-Dichlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,1-Dichloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,2-Dichloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	3,100	15,000	0.38	
1,2-Dichloroethene (total)	ug/L	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NS	NS	NS	
1,1-Dichloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1,500	7,500	33	
cis-1,2-Dichloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
trans-1,2-Dichloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1,400	6,800	140	
1,2-Dichloropropane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2,200	11,000	NS	
cis-1,3-Dichloropropene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
trans-1,3-Dichloropropene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
Ethylbenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	580	2,900	530	
2-Hexanone	ug/L	ND (25.0)	ND (25.0)	ND (25.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	4,300	21,000	NS	
Isopropylbenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
p-Isopropyltoluene	ug/L	14.8	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
Methylene Chloride	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2,400	12,000	4.6	
4-Methyl-2-pentanone (MIBK)	ug/L	ND (25.0)	ND (25.0)	ND (25.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	5,000	26,000	NS	
MTBE	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
n-Propylbenzene	ug/L	9.9	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
Styrene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,1,2,2-Tetrachloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	210	1,000	0.17	
Tetrachloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	140	700	0.69	
Toluene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	330	1,700	1,300	
1,2,4-Trichlorobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
1,1,1-Trichloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	610	3,000	NS	
1,1,2-Trichloroethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	680	3,400	0.59	
Trichloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	450	2,300	2.5	
Vinyl Chloride	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	0.025	

**Table 2**  
**Analytical Results**  
**Surface Water**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>			
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland	Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria		
		Sample Date	9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
Volatile Organic Compounds														
Xylene (total)	ug/L	NA	NA	NA	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	210	110	70,000	
m,p-Xylenes	ug/L	12.3	ND (5.0)	ND (5.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NS	NS	NS	
o-Xylene	ug/L	6.5	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	NS	NS	
Dibromomethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Diethyl Ether	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Ethyl methacrylate	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Hexachlorobutadiene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Iodomethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Methacrylonitrile	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Methyl acrylate	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Methyl methacrylate	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Naphthalene	ug/L	13.7	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Nitrobenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Tert-butyl alcohol	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Tert-butylbenzene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Tetrachloroethene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
trans-1,4-Dichloro-2-butene	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Trichlorofluoromethane	ug/L	ND (5.0)	ND (5.0)	ND (5.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	

Table 2  
Analytical Results  
Surface Water  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>		
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland		Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria
Sample Date		9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
<b>Semi-Volatile Organic Compounds</b>													
bis(2-Chloroethoxy)methane	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,4-Dichlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	340	1,700	77
1,2,4-Trichlorobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	26	130	35
Naphthalene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	43	140	NS
4-Chloroaniline	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Dimethyl phthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Acenaphthylene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,6-Dinitrotoluene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	200	990	0.05
Acenaphthene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,4-Dinitrophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	130	660	69
Hexachlorobutadiene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	2	10	0.44
2-Chloronaphthalene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	1000
4-Chloro-3-methylphenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2-Methylnaphthalene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1-Methylnaphthalene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Hexachlorocyclopentadiene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	1	5	40
2,4,6-Trichlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	91	460	1.4
2,4,5-Trichlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,4-Dinitrotoluene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	320	1,600	0.05
Chrysene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
bis(2-Ethylhexyl)Phthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	910	4,500	1.2
di-N-Octylphthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Acenaphthene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	17	83	670
Benzo (b)fluoranthene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
Benzo (k)fluoranthene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
Benzo(a)pyrene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
Indeno(1,2,3-cd)pyrene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
Dibenzo(a,h)anthracene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.0038
Benzo(g,h,i)perylene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
4-Nitrophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	470	2,300	NS
Dibenzofuran	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,3,5,6-Tetrachlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2,3,4,6-Tetrachlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
4-Nitroaniline	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Azobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS

Table 2  
Analytical Results  
Surface Water  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>		
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland		Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria
Sample Date		9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
<b>Semi-Volatile Organic Compounds</b>													
Carbazole	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
bis(2-Ethylhexyl)adipate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
n-Nitroso-dimethylamine	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	3,400	17,000	0.00069
Phenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	21000
Pyridine	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Aniline	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
2-Methylphenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
3/4-Methylphenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
bis(2-Chloroethyl)ether	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	6,000	30,000	0.03
2-Chlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	110	560	81
1,3-Dichlorobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	69	350	420
1,4-Dichlorobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	150	730	420
1,2-Dichlorobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	160	820	420
Benzyl alcohol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
bis(2-Chloroisopropyl)ether	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	1,400
n-Nitroso-di-n-propylamine	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.005
Hexachloroethane	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	12	60	1.4
2-Chlorophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Nitrobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	810	4,000	17
Isophorone	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	2,100	10,000	35
2-Nitrophenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	1,600	8,000	NS
2,4-Dimethylphenol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	130	660	380
Diethyl phthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	800	4,000	17,000
1,4-Dinitrobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
1,3-Dinitrobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
Fluorene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	1100
4-Chlorophenylphenylether	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS
4,6-Dinitro-o-cresol	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	16	80	13
n-Nitrosodiphenylamine	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	59	3,000	3.3
4-Bromophenylphenylether	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	54	270	NS
Hexachlorobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	0.00028
Pentachlorophenol	ug/L	ND (50.0)	ND (50.0)	ND (50.0)	NA	NA	NA	NA	NA	NA	4.0	5.3	0.27
3-Nitroaniline	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS

**Table 2**  
**Analytical Results**  
**Surface Water**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	Units	#1 Swale (Catchment Basin) at Corner of Drill Site	#3 Creek after Site (Downgradient Sample)	#4 Creek before Site (Upgradient Sample)	SC-D1	SC-D2	SC-U1	SC-U2	HWL-1	HWL-2	Surface Water Quality Criteria <sup>3</sup>			
		Data Reported on an "as received" Basis (Unfiltered Samples)			Stevens Creek Downgradient of Wetland	Stevens Creek Upgradient of Wetland		Heitsman # 4H Wetland	Wetland Across Stevens Creek	Fish and Aquatic Life Criteria - Chronic	Fish and Aquatic Life Criteria - Acute	Human Health Criteria		
		Sample Date	9/17/2009	9/17/2009	9/17/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/19/2009	11/19/2009			
Semi-Volatile Organic Compounds														
Phenanthrene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	1	5	NS	
Anthracene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	8,300	
di-N-Butyl phthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	21	110	2,000	
1,2-Dinitrobenzene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Fluoranthene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	40	200	130	
Pyrene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	830	
Butylbenzylphthalate	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	35	140	150	
Benzo(a)anthracene	ug/L	ND (50.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	0.1	0.5	0.0038	
Wet Chemistry Parameters														
Total Suspended Solids	mg/L	52	174	4.0	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Total Dissolved Solids	mg/L	800	480	100	NA	NA	NA	NA	NA	NA	NS	NS	500/750 <sup>4</sup>	
Oil & Grease	mg/L	ND (10.0)	ND (10.0)	ND (10.0)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
MBAS	mg/L	ND (0.040)	0.085	ND (0.020)	NA	NA	NA	NA	NA	NA	NS	NS	NS	
Chloride	mg/L	226	209	36.1	NA	NA	NA	NA	NA	NA	NS	NS	250	

Notes:  
1 = Reported as Chromium III for samples collected 9/17/09 and total chromium for samples collected 11/18/09 and 11/19/09.  
2 = ND (1.0) = Parameter not detected above reporting limit in parentheses.  
3 = Values from 25 Pa Code Chapter 93.8, Table 5 and 25 Pa Code Chapter 16.102, Appendix A, Table 1; values assume a pH of 6.5 SU and hardness of 100 mg/L, where applicable. Values provided for chromium are for chromium III.  
Values for Manganese and Iron from 25 Pa Code Chapter 93.7, Table 3.  
4 = Value reported as 1.5 mg/L as 30 day average as total recoverable iron and maximum as 0.3 mg/L as dissolved.  
5 = Value reported for Mn as total recoverable.  
8 = TDS reported as 500 mg/L as a monthly average and 750 mg/L as maximum allowed.  
7 = Reported as total metals for samples collected 9/17/09 and dissolved metals for samples collected 11/18/09 and 11/19/09.  
NA = Not analyzed.  
NS = No standard available.  
0.23 = Value exceeds one or more Surface Water Quality Criteria.

**Table 3a**  
**Analytical Results**  
**Suldge Sample (Soild Fraction)**  
**September 17, 2009**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	UNITS	#2 Mud Pump at Corner of Drill Site	Residential Direct Contact MSC <sup>1</sup>	Residential Used Aquifer MSC <sup>2</sup>
<b>Total Metals</b>				
Aluminum	mg/kg	6,020	190,000	NS
Arsenic	mg/kg	6.9	12	150
Barium	mg/kg	52.2	15,000	8,200
Beryllium	mg/kg	0.37	440	320
Boron	mg/kg	ND (4.2) <sup>3</sup>	20,000	60
Cadmium	mg/kg	ND (0.17)	47	38
Calcium	mg/kg	1,340	NS*	NS
Chromium III	mg/kg	9.4	190,000	190,000
Cobalt	mg/kg	5.5	4,400	73
Copper	mg/kg	9.1	8,200	36,000
Iron	mg/kg	11,500	66,000	NS
Lead	mg/kg	12.8	500	450
Lithium	mg/kg	15.2	NS	NS
Magnesium	mg/kg	2,180	NS	NS
Manganese	mg/kg	374	31,000	NS
Molybdenum	mg/kg	1	NS	NS
Nickel	mg/kg	11.2	4,400	650
Potassium	mg/kg	1,160	NS	NS
Selenium	mg/kg	ND (0.42)	1,100	26
Silver	mg/kg	ND (0.17)	1,100	84
Sodium	mg/kg	476	NS	NS
Strontium	mg/kg	8.3	NS	NS
Zinc	mg/kg	40	66,000	12,000
Mercury	mg/kg	ND (0.092)	66	10
<b>Volatile Organic Compounds</b>				
Dichlorodifluoromethane	ug/kg	ND (5.0)	3,800,000	100,000
Chloromethane	ug/kg	ND (5.0)	180,000	300
Vinyl Chloride	ug/kg	ND (5.0)	12,000	200
Bromomethane	ug/kg	ND (5.0)	95,000	1,000
Chloroethane	ug/kg	ND (5.0)	6,200,000	23,000
Trichlorofluoromethane	ug/kg	ND (5.0)	10,000,000	200,000
Diethyl Ether	ug/kg	ND (5.0)	NS	NS
1,1-Dichloroethene	ug/kg	ND (5.0)	6,400	700
Allyl Chloride	ug/kg	ND (5.0)	19,000	280
Carbon Disulfide	ug/kg	ND (5.0)	10,000,000	190,000
1,1,2-trichlorotrifluoroethane	ug/kg	ND (5.0)	190,000,000	26,000,000
Iodomethane	ug/kg	ND (5.0)	NS	NS
Methylene Chloride	ug/kg	ND (5.0)	680,000	500
Acetone	ug/kg	ND (25.0)	10,000,000	370,000
trans-1,2-Dichloroethene	ug/kg	ND (5.0)	1,300,000	10,000
MTBE	ug/kg	ND (5.0)	620,000	2,000
tert-Butyl alcohol	ug/kg	ND (5.0)	NS	NS
Chloroprene	ug/kg	ND (5.0)	130,000	1,900
Acrylonitrile	ug/kg	ND (5.0)	4,700	63
1,1-Dichloroethane	ug/kg	ND (5.0)	200,000	2,700
cis-1,2-Dichloroethene	ug/kg	ND (5.0)	670,000	7,000
2,2-Dichloropropane	ug/kg	ND (5.0)	NS	NS
Bromochloromethane	ug/kg	ND (5.0)	2,200,000	9,000
Chloroform	ug/kg	ND (5.0)	6,000	10,000
Methyl acrylate	ug/kg	ND (5.0)	6,600,000	110,000
Carbon tetrachloride	ug/kg	ND (5.0)	21,000	500
1,1,1-Trichloroethane	ug/kg	ND (5.0)	10,000,000	20,000
2-Butanone	ug/kg	ND (25.0)	10,000,000	280,000
1,1-Dichloropropene	ug/kg	ND (5.0)	NS	NS
Benzene	ug/kg	ND (5.0)	41,000	500
Methacrylonitrile	ug/kg	ND (5.0)	13,000	190
1,2-Dichloroethane	ug/kg	ND (5.0)	12,000	500
Trichloroethene	ug/kg	ND (5.0)	190,000	500
Dibromomethane	ug/kg	ND (5.0)	670,000	9,700

**Table 3a**  
**Analytical Results**  
**Suldge Sample (Soild Fraction)**  
**September 17, 2009**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	UNITS	#2 Mud Pump at Corner of Drill Site	Residential Direct Contact MSC <sup>1</sup>	Residential Used Aquifer MSC <sup>2</sup>
<b>Volatile Organic Compounds</b>				
1,2-Dichloropropane	ug/kg	ND (5.0)	31,000	500
Bromodichloromethane	ug/kg	ND (5.0)	8600	10,000
Methyl methacrylate	ug/kg	ND (5.0)	10,000,000	190,000
2-Chloroethyl vinyl ether	ug/kg	ND (5.0)	NS	NS
cis-1,3-Dichloropropene	ug/kg	ND (5.0)	80,000	660
Toluene	ug/kg	ND (5.0)	7,600,000	100,000
2-Nitropropane	ug/kg	ND (5.0)	120	1.6
4-Methyl-2-pentanone	ug/kg	ND (25.0)	1,500,000	19,000
Tetrachloroethene	ug/kg	ND (5.0)	340,000	500
Chloroacetonitrile	ug/kg	ND (5.0)	NS	NS
trans-1,3-Dichloropropene	ug/kg	ND (5.0)	80,000	660
Ethyl methacrylate	ug/kg	ND (5.0)	NS	87,000
1,1,2-Trichloroethane	ug/kg	ND (5.0)	20,000	500
Dibromochloromethane	ug/kg	ND (5.0)	12,000	10,000
1,3-Dichloropropane	ug/kg	ND (5.0)	NS	NS
1,2-Dibromoethane	ug/kg	ND (5.0)	NS	NS
2-Hexanone	ug/kg	ND (25.0)	NS	NS
Ethylbenzene	ug/kg	ND (5.0)	NS	70,000
Chlorobenzene	ug/kg	ND (5.0)	4,400,000	10,000
1,1,1,2-Tetrachloroethane	ug/kg	ND (5.0)	690,000	18,000
m,p-Xylenes	ug/kg	ND (10.0)	8,000,000	1,000,000
o-Xylene	ug/kg	ND (5.0)	8,000,000	1,000,000
Styrene	ug/kg	ND (5.0)	10,000,000	24,000
Bromoform	ug/kg	ND (5.0)	290,000	10,000
Isopropylbenzene	ug/kg	ND (5.0)	7,300,000	780,000
cis-1,4-Dichloro-2-butene	ug/kg	ND (5.0)	91,000,000	1.6
n-Propylbenzene	ug/kg	ND (5.0)	8,800,000	290,000
Bromobenzene	ug/kg	ND (5.0)	NS	NS
1,1,2,2-Tetrachloroethane	ug/kg	ND (5.0)	5,500	30
1,3,5-Trimethylbenzene	ug/kg	ND (5.0)	110,000	2,800
2-Chlorotoluene	ug/kg	ND (5.0)	4,400,000	10,000
1,2,3-Trichloropropane	ug/kg	ND (5.0)	160	4,000
trans-1,4-Dichloro-2-butene	ug/kg	ND (5.0)	91,000,000	1.6
4-Chlorotoluene	ug/kg	ND (5.0)	NS	NS
tert-Butylbenzene	ug/kg	ND (5.0)	8,800,000	270,000
1,2,4-Trimethylbenzene	ug/kg	ND (5.0)	110,000	9,000
sec-Butylbenzene	ug/kg	ND (5.0)	8,800,000	350,000
p-Isopropyltoluene	ug/kg	ND (5.0)	NS	NS
1,3-dichlorobenzene	ug/kg	ND (5.0)	6,600,000	61,000
1,4-Dichlorobenzene	ug/kg	ND (5.0)	750,000	10,000
n-Butylbenzene	ug/kg	ND (5.0)	8,800,000	950,000
1,2-Dichlorobenzene	ug/kg	ND (5.0)	3,800,000	60,000
1,2-Dibromo-3-chloropropane	ug/kg	ND (5.0)	3,800	20
Nitrobenzene	ug/kg	ND (5.0)	110,000	1,800
Hexachlorobutadiene	ug/kg	ND (5.0)	44,000	1,200
1,2,4-Trichlorobenzene	ug/kg	ND (5.0)	2,200,000	27,000
Naphthalene	ug/kg	ND (5.0)	4,400,000	25,000
1,2,3-Trichlorobenzene	ug/kg	ND (5.0)	NS	NS

Notes:

<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential Direct Contact Values. PA Department of Environmental Protection, Appendix A, Tables 3A and 4A of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations.

<sup>2</sup> = Medium-Specific Concentrations (MSCs) were established from the Soil to Groundwater Pathway, Residential, Used Aquifer with TDS ≤ 2500 MSCs Soil to Groundwater Numeric Values listed in Appendix A, Tables 3B and 4B of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations.

<sup>3</sup> = ND (4.2) = Parameter not detected above reporting limit in parentheses.

<sup>4</sup> = No standard available.

**36.1** = Result exceeds SHS, Residential Used Aquifer MSC or Direct Contact Value.

**Table 3b**  
**Analytical Results**  
**Sludge Sample (Liquid Fraction)**  
**September 17, 2009**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	UNITS	#2 Mud Pump at Corner of Drill Site	Residential Used Aquifer MSC <sup>1</sup>
<b>General Chemistry</b>			
Total Solids	mg/L	489,550	NS <sup>3</sup>
Oil & Grease	mg/kg	292	NS
MBAS	mg/L	ND (1.00) <sup>2</sup>	NS
Chloride	mg/L	1,830	250 <sup>4</sup>
<b>Semi-Volatile Organic Compounds</b>			
bis(2-chloroethoxy)methane	ug/L	ND (100)	NS
2,4-dichlorophenol	ug/L	ND (100)	20
1,2,4-trichlorobenzene	ug/L	ND (100)	70
naphthalene	ug/L	ND (100)	100
4-chloroaniline	ug/L	ND (100)	150
dimethyl phthalate	ug/L	ND (100)	NS
acenaphthylene	ug/L	ND (100)	2,200
2,6-dinitrotoluene	ug/L	ND (100)	37
acenaphthene	ug/L	ND (100)	2,200
2,4-dinitrophenol	ug/L	ND (100)	19
hexachlorobutadiene	ug/L	ND (100)	1
2-chloronaphthalene	ug/L	ND (100)	2,900
4-chloro-3-methylphenol	ug/L	ND (100)	180
2-methylnaphthalene	ug/L	ND (100)	730
1-methylnaphthalene	ug/L	ND (100)	NS
hexachlorocyclopentadiene	ug/L	ND (100)	50
2,4,6-trichlorophenol	ug/L	ND (100)	11
2,4,5-Trichlorophenol	ug/L	ND (100)	3,700
2,4-dinitrotoluene	ug/L	ND (100)	2.1
chrysene	ug/L	ND (100)	1.9
bis(2-ethylhexyl)phthalate	ug/L	ND (100)	6
di-n-octyl phthalate	ug/L	ND (100)	730
acenaphthene	ug/L	ND (100)	2,200
benzo(b)fluoranthene	ug/L	ND (100)	0.9
benzo(k)fluoranthene	ug/L	ND (100)	0.55
benzo(a)pyrene	ug/L	ND (100)	0.2
indeno(1,2,3-cd)pyrene	ug/L	ND (100)	0.9
dibenzo(a,h)anthracene	ug/L	ND (100)	0.09
Benzo(g,h,i)perylene	ug/L	ND (100)	0.26
4-nitrophenol	ug/L	ND (100)	60
dibenzofuran	ug/L	ND (100)	NS
2,3,5,6-tetrachlorophenol	ug/L	ND (100)	NS
2,3,4,6-tetrachlorophenol	ug/L	ND (100)	290
4-nitroaniline	ug/L	ND (100)	2.1
azobenzene	ug/L	ND (100)	NS
carbazole	ug/L	ND (100)	33
bis(2-ethylhexyl)adipate	ug/L	ND (100)	NS
n-nitroso-dimethylamine	ug/L	ND (100)	0.0031
phenol	ug/L	ND (100)	4,000
pyridine	ug/L	ND (100)	9.7

**Table 3b**  
**Analytical Results**  
**Sludge Sample (Liquid Fraction)**  
**September 17, 2009**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

PARAMETER	UNITS	#2 Mud Pump at Corner of Drill Site	Residential Used Aquifer MSC <sup>1</sup>
<b><i>Semi-Volatile Organic Compounds</i></b>			
aniline	ug/L	ND (100)	2.8
2-methylphenol	ug/L	ND (100)	1,800
3 & 4-methylphenol	ug/L	ND (100)	180
bis(2-chloroethyl)ether	ug/L	ND (100)	0.13
2-chlorophenol	ug/L	ND (100)	40
1,3-dichlorobenzene	ug/L	ND (100)	600
1,4-dichlorobenzene	ug/L	ND (100)	75
1,2-dichlorobenzene	ug/L	ND (100)	600
benzyl alcohol	ug/L	ND (100)	11,000
bis(2-chloroisopropyl)ether	ug/L	ND (100)	300
n-nitroso-di-n-propylamine	ug/L	ND (100)	0.094
hexachloroethane	ug/L	ND (100)	1
2-chlorophenol	ug/L	ND (100)	40
nitrobenzene	ug/L	ND (100)	18
isophorone	ug/L	ND (100)	100
2-nitrophenol	ug/L	ND (100)	290
2,4-dimethylphenol	ug/L	ND (100)	730
diethyl phthalate	ug/L	ND (100)	5,000
1,4-dinitrobenzene	ug/L	ND (100)	NS
1,3-dinitrobenzene	ug/L	ND (100)	1
fluorene	ug/L	ND (100)	1,500
4-chlorophenylphenyl ether	ug/L	ND (100)	NS
Fluorene	ug/L	ND (100)	1,500
4,6-dinitro-o-cresol	ug/L	ND (100)	NS
n-nitrosodiphenylamine	ug/L	ND (100)	130
4-bromophenylphenylether	ug/L	ND (100)	NS
hexachlorobenzene	ug/L	ND (100)	1
pentachlorophenol	ug/L	ND (600)	1
3-nitroaniline	ug/L	ND (100)	2.1
phenanthrene	ug/L	ND (100)	1,100
anthracene	ug/L	ND (100)	66
di-n-butyl phthalate	ug/L	ND (100)	3,700
1,2-dinitrobenzene	ug/L	ND (100)	NS
fluoranthene	ug/L	ND (100)	260
pyrene	ug/L	ND (100)	130
butylbenzylphthalate	ug/L	ND (100)	2,700
benzo(a)anthracene	ug/L	ND (100)	0.9

**Notes:**

<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential, Used Aquifer with TDS ≤ 2500 Values listed in Appendix A, Table 1 of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations, except as noted.

<sup>2</sup> = ND (1.00) = Parameter not detected above reporting limit in parentheses.

<sup>3</sup> = No standard available.

<sup>4</sup> = Secondary MCL value.

**1,830** = Result exceeds SHS, Residential Used Aquifer MSC.

Table 4  
Analytical Results  
Confirmational Sample Results for VOCs and SVOCs in Soil  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

Sample I.D. (Field)	H-1	H-2	H-3	H-4	H-5	H-6	H-7	H-8	H-8A	H-10	H-11	H-12	H-13	SOIL MSCs <sup>1</sup>	SATURATED SOIL MSC (0.1 x SHS MSC) <sup>2</sup>
Sample Date	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009		
8260 Analyses															
Acetone	109	ND (0.465)	0.0532	0.129	0.247	0.257	0.307	0.438	0.0181	0.299	0.444	0.192	0.0107	370	4.1
Benzene	ND (0.0077) <sup>3</sup>	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.013
Bromodichloromethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	8.6	0.34
Bromoforn	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	NS <sup>4</sup>	NS
Bromomethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	1	0.054
2-Butanone (MEK)	ND (0.0155)	ND (0.465)	ND (0.0131)	ND (0.0224)	ND (0.0205)	ND (0.0149)	0.0538	ND (0.0175)	ND (0.0149)	ND (0.0554)	0.0442	ND (0.0331)	ND (0.0081)	280	5.4
n-Butylbenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	0.252	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	950	95
sec-Butylbenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.0224	0.138	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	0.0258	350	35
Carbon disulfide	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	190	16
Carbon tetrachloride	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.026
Chlorobenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	10	0.61
Chloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	23	0.5
Chloroform	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	6	0.25
Chloromethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	NS	NS
Dibromochloromethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	NS	NS
1,2-Dichlorobenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	60	5.9
1,3-Dichlorobenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	61	6.1
1,4-Dichlorobenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	10	1
1,1-Dichloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	2.7	0.065
1,2-Dichloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.01
1,2-Dichloroethene (Total)	ND (0.0155)	ND (0.465)	ND (0.0131)	ND (0.0224)	ND (0.0205)	ND (0.0149)	ND (0.0092)	ND (0.0175)	ND (0.0149)	ND (0.0554)	ND (0.0299)	ND (0.0331)	ND (0.0081)	NS	NS
1,1-Dichloroethene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.7	0.019
cis-1,2-Dichloroethene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	7	0.16
trans-1,2-Dichloroethene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	10	0.23
1,2-Dichloropropane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.011
cis-1,3-Dichloropropene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.66	0.012
trans-1,3-Dichloropropene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	NS	NS
Ethylbenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.0053	0.0112	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	70	4.6
2-Hexanone	ND (0.0155)	ND (0.465)	ND (0.0131)	ND (0.0224)	ND (0.0205)	ND (0.0149)	ND (0.0092)	ND (0.0175)	ND (0.0149)	ND (0.0554)	ND (0.0299)	ND (0.0331)	ND (0.0081)	NS	NS
Isopropylbenzene (Cumene)	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.0055	0.0210	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	780	78
p-Isopropyltoluene	ND (0.0077)	0.344	ND (0.0066)	ND (0.0112)	ND (0.0103)	0.0136	0.0795	0.496	ND (0.0074)	ND (0.0277)	0.0977	ND (0.0165)	ND (0.0041)	NS	NS
Methylene Chloride	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.05
4-Methyl-2-pentanone (MIBK)	ND (0.0155)	ND (0.465)	ND (0.0131)	ND (0.0224)	ND (0.0205)	ND (0.0149)	ND (0.0092)	ND (0.0175)	ND (0.0149)	ND (0.0554)	ND (0.0299)	ND (0.0331)	ND (0.0081)	NS	NS
Methyl-tert-butyl ether	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	2	0.028
Naphthalene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.0375	0.0929	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	25	2.5
n-Propylbenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	290	29
Styrene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	24	2.4
1,1,2,2-Tetrachloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.03	0.00093
Tetrachloroethene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.043
Toluene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.334	0.0735	ND (0.0074)	ND (0.0277)	0.461	0.0512	ND (0.0041)	100	4.4
1,1,1-Trichloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	20	0.72
1,1,2-Trichloroethane	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.015
Trichloroethene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.5	0.017
1,2,4-Trimethylbenzene	ND (0.0077)	0.552	ND (0.0066)	ND (0.0112)	ND (0.0103)	0.0536	0.241	2.43	ND (0.0074)	ND (0.0277)	0.199	ND (0.0165)	0.234	9	0.9
1,3,5-Trimethylbenzene	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	0.0215	0.096	0.597	ND (0.0074)	ND (0.0277)	0.0743	ND (0.0165)	0.104	2.8	0.28
Vinyl chloride	ND (0.0077)	ND (0.233)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	ND (0.0046)	ND (0.0088)	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	0.2	0.0027
Xylenes (total)	ND (0.0232)	ND (0.696)	ND (0.0197)	ND (0.0336)	ND (0.0308)	ND (0.0224)	0.0350	0.0651	ND (0.0223)	ND (0.0831)	ND (0.0449)	ND (0.0496)	ND (0.0122)	1,000	99
m&p-Xylene	ND (0.0155)	ND (0.465)	ND (0.0066)	ND (0.0112)	ND (0.0103)	ND (0.0075)	0.0236	0.0414	ND (0.0149)	ND (0.0554)	ND (0.0299)	ND (0.0331)	ND (0.0081)	1,000	99
o-Xylene	ND (0.0077)	ND (0.465)	ND (0.0131)	ND (0.0224)	ND (0.0205)	ND (0.0149)	0.0114	0.0237	ND (0.0074)	ND (0.0277)	ND (0.0150)	ND (0.0165)	ND (0.0041)	1,000	99
8270 Analyses															
Acenaphthene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA <sup>5</sup>	NA	NA	NA	NA	2,700	270
Acenaphthylene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2,500	250
Anthracene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	350	35
Benzo(a)anthracene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	25	7.9
Benzo(a)pyrene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2.5	4.6
Benzo(b)fluoranthene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.7										

Table 4  
Analytical Results  
Confirmational Sample Results for VOCs and SVOCs in Soil  
Heitsman #2V#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

Sample I.D. (Field)	H-1	H-2	H-3	H-4	H-5	H-6	H-7	H-8	H-8A	H-10	H-11	H-12	H-13	SOIL MSCs <sup>1</sup>	SATURATED SOIL MSC (0.1 X SHS MSC) <sup>2</sup>
Sample Date	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	9/22/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009	11/18/2009		
8270 Analyses (continued)															
bis(2-Chloroethoxy)methane	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	NS	NS
bis(2-Chloroethyl) ether	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	0.013	0.00039
bis(2-Chloroisopropyl) ether	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	30	0.8
2-Chloronaphthalene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	6,200	620
2-Chlorophenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	4.4	0.44
4-Chlorophenylphenyl ether	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	NS	NS
Chrysene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	230	23
Dibenz(a,h)anthracene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2.5	4.1
Dibenzofuran	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	NS	NS
1,2-Dichlorobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	60	5.9
1,3-Dichlorobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	61	6.1
1,4-Dichlorobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	10	1
3,3'-Dichlorobenzidine	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	8.3	0.83
2,4-Dichlorophenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2	0.1
Diethylphthalate	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	500	16
2,4-Dimethylphenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	73	3.2
Dimethylphthalate	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	NS	NS
Di-n-butylphthalate	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	NS	NS
4,6-Dinitro-2-methylphenol	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	NS	NS
2,4-Dinitrophenol	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	1.9	0.021
2,4-Dinitrotoluene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	0.21	0.005
2,6-Dinitrotoluene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	3.7	0.11
Di-n-octylphthalate	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	4400	1000
bis(2-Ethylhexyl)phthalate	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	130	13
Fluoranthene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	3,200	320
Fluorene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	3,000	300
Hexachloro-1,3-butadiene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	1.2	0.12
Hexachlorobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	0.96	0.096
Hexachlorocyclopentadiene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	91	9.1
Hexachloroethane	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	0.66	0.066
Indeno(1,2,3-cd)pyrene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	25	7000
Isophorone	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	10	0.19
2-Methylnaphthalene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2,900	290
2-Methylphenol(o-Cresol)	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	180	6.4
3&4-Methylphenol(m&p Cresol)	ND (1.150)	ND (0.854)	ND (0.932)	ND (1.390)	ND (1.530)	ND (1.040)	ND (0.874)	ND (0.976)	NA	NA	NA	NA	NA	198	4.02
Naphthalene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	25	2.5
2-Nitroaniline	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	0.21	0.0033
3-Nitroaniline	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	0.21	0.0038
4-Nitroaniline	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	0.21	0.0031
Nitrobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	1.8	0.079
2-Nitrophenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	29	0.59
4-Nitrophenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	6	0.41
N-Nitroso-di-n-propylamine	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	0.0094	0.00013
N-Nitrosodiphenylamine	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	20	2.0
Pentachlorophenol	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	5	0.50
Phenanthrene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	10,000	1,000
Phenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	400	6.6
Pyrene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	2,200	220
1,2,4-Trichlorobenzene	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	27	2.7
2,4,5-Trichlorophenol	ND (1.440)	ND (1.070)	ND (1.170)	ND (1.740)	ND (1.910)	ND (1.310)	ND (1.090)	ND (1.210)	NA	NA	NA	NA	NA	2,300	230
2,4,6-Trichlorophenol	ND (0.576)	ND (0.427)	ND (0.466)	ND (0.696)	ND (0.765)	ND (0.522)	ND (0.437)	ND (0.484)	NA	NA	NA	NA	NA	3.1	0.31

Notes:  
All results reported in milligram per kilogram (mg/kg).  
<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential, Used Aquifer with TDS < 2500 MSCs Soil to Groundwater Numeric Values listed in Appendix A, Table 3 and Table 4 of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations.  
<sup>2</sup> = Saturated soil has a MSC of 1/10 generic SHS MSC according to PA Code §§ 250.308 (2)(i).  
<sup>3</sup> = ND (0.0077) = Parameter not detected above the reporting limit in parentheses.  
<sup>4</sup> = No standard available.  
<sup>5</sup> = Not analyzed.

2.43

= Result exceeds SHS Residential, Used Aquifer Saturated Soil MSC.

Table 5  
Analytical Results  
Confirmational Sample Results for Metals in Soil  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

Sample I.D. (Field)	H4R	H10R	H11R	H12R	H5R	H13	H14	H15	H16	H17	SOIL Residential Used Aquifer MSCs <sup>1</sup>	SATURATED SOIL MSCs <sup>2</sup> (0.1 X SHS MSC)
Sample Date	3/10/2010	3/10/2010	3/10/2010	3/10/2010	3/10/2010	3/10/2010	3/10/2010	4/27/2010	4/27/2010	4/17/2010		
Percent Moisture	54.3%	79.3%	90.3%	48.2%	74.7%	53.0%	83.1%	23.2%	25.3%	35.0%	NS <sup>4</sup>	NS
6010/7471 Metals Analyses												
Aluminum	15,400	19,600	38,800	13,700	6,640	13,400	6,500	13,600	16,000	10,300	190,000	NS
Antimony	ND (0.99) <sup>3</sup>	ND (1.9)	ND (4.1)	ND (0.65)	ND (1.8)	ND (0.63)	ND (2.3)	0.61	0.53	ND (0.46)	27	2.7
Arsenic	6.1	10.6	29.3	3.7	6.7	10.1	4.2	9.7	13.6	6.4	12	15
Barium	165	3,040	1,680	122	93.4	1,140	159	270	105	71.1	8,200	820
Beryllium	0.60	0.88	2.0	0.44	ND (0.72)	0.59	ND (0.91)	0.60	0.62	0.34	320	32
Boron	ND (9.9)	ND (18.9)	ND (40.9)	ND (6.5)	ND (17.9)	ND (0.63)	ND (22.7)	6.6	6.6	5.2	60	0.67
Cadmium	0.75	1.4	2.5	0.36	0.83	0.56	1.1	ND (0.22)	ND (0.20)	ND (0.18)	38	3.8
Calcium	1,790	3,860	11,100	1,390	ND (718)	2,200	4,190	843	678	637	NS	NS
Chromium	12.9	19.9	39.1	10.9	6.3	13.6	3.5	16.1	18.7	10.6	94	19,000
Cobalt	5.4	10.8	29.0	3.9	ND (3.6)	7.7	ND (4.5)	9.4	9.3	4.9	73	0.81
Copper	8.8	18.3	40.6	5.8	18.7	10.6	14.0	10.5	11.6	7.0	8,200	3,600
Iron	13,400	24,900	67,100	9,970	9,360	23,900	8,290	27,100	30,100	17,700	66,000	NS
Lead	25.6	49.8	59.9	23.1	86.9	28.2	190	11.4	15.8	10.0	450	45
Magnesium	2,070	3,610	8,400	1,830	345	2,580	727	3,230	3,400	1800	NS	NS
Manganese	248	448	1,880	116	22.8	302	153	376	357	153	31,000	NS
Molybdenum	ND (4.0)	ND (7.6)	ND (16.4)	ND (2.6)	ND (7.2)	ND (2.5)	ND (9.1)	ND (2.2)	ND (2.0)	ND (1.8)	NS	NS
Nickel	11.7	22.4	50.9	9.1	7.5	14.3	ND (9.1)	18.3	18.1	10	650	65
Potassium	1,360	2,490	6,450	1,280	669	1,630	1,760	1,890	2,150	1340	NS	NS
Selenium	1.1	ND (1.9)	ND (4.1)	0.78	3.7	ND (0.63)	3.6	ND (0.54)	ND (0.50)	ND (0.46)	26	2.6
Silver	ND (0.40)	ND (0.76)	ND (1.6)	ND (0.26)	ND (0.72)	ND (0.25)	ND (0.91)	ND (0.22)	ND (0.20)	ND (0.18)	84	8.4
Sodium	ND (994)	ND (1,890)	ND (4,090)	ND (652)	ND (1,790)	ND (633)	ND (2,270)	ND (543)	ND (499)	ND (458)	NS	NS
Thallium	ND (4.0)	ND (7.6)	ND (16.4)	ND (2.6)	ND (7.2)	ND (2.5)	ND (8.1)	ND (2.2)	ND (2.0)	ND (1.8)	14	1.4
Vanadium	18.7	27.1	54.9	16.3	11.8	22.9	7.4	22.9	28.2	19.3	1,500	2,600
Zinc	66.0	135.0	221	44.4	36.8	56.9	40.6	47.2	58.3	29.7	12,000	1,200
Mercury	ND (0.22)	ND (0.48)	ND (0.97)	ND (0.19)	ND (0.37)	ND (0.21)	ND (0.58)	ND (0.13)	ND (0.13)	ND (0.15)	10	1

Notes:  
All results in milligram per kilogram (mg/kg) unless otherwise stated.  
<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential, Used Aquifer with TDS < 2500 MSCs Soil to Groundwater Numeric Values listed in Appendix A, Table 3 and Table 4 of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations.  
<sup>2</sup> = Saturated soil has an MSC of 1/10 generic SHS MSC according to PA Code §§ 250.308 (2)(ii).  
<sup>3</sup> = ND (0.99) = Parameter not detected at the detection limit specified in parentheses.  
<sup>4</sup> = No standard available.  
29.3 =Result exceeds SHS Residential, Used Aquifer MSC.  
5.4 =Result exceeds SHS Residential, Used Aquifer MSC; however, results do not exceed the Background Standard

**Table 6**  
**Analytical Results**  
**Synthetic Precipitation Leaching Procedure Results for Metals in**  
**Selected Soil Samples**  
**Heitsman #2V/#4H Wellsite**

Dimock Township  
Susquehanna County  
Pennsylvania

<b>Sample I.D. (Field)</b>	<b>H4R</b>	<b>H10R</b>	<b>H11R + H13R</b>	<b>H12R</b>	<b>MSC<sup>1</sup> Residential Used Aquifer TDS ≤2500</b>
Sample Date	3/10/2010	3/10/2010	3/10/2010	3/10/2010	
<b>6010/7471 Metals Analyses</b>					
Arsenic	2.2J	4.2J	5.4J	ND<50 - MDL=1.0	<b>50</b>
Barium	130J	130J	99J	380J	<b>2,000</b>
Cobalt	ND<50 - MDL=0.2	1.1J	0.7J	0.35J	<b>730</b>
Lead	ND<50 - MDL=0.7	<b>5.6J</b>	<b>6J</b>	1.3J	<b>5</b>
Selenium	0.99J	ND<100 - MDL=0.8	2.3J	1.4J	<b>50</b>

**Notes:**

All results in microgram per liter (µg/L).

<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential, Used Aquifer with TDS ≤ 2500 Values listed in Appendix A, Table 2 of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations, except as noted.

<sup>2</sup> = ND<50 - MDL=0.2 = Parameter not quantifiably detected at the detection limit specified (ND), but concentration estimated above the method detection limit (MDL).

**29.3** =Result exceeds SHS Residential, Used Aquifer MSC.

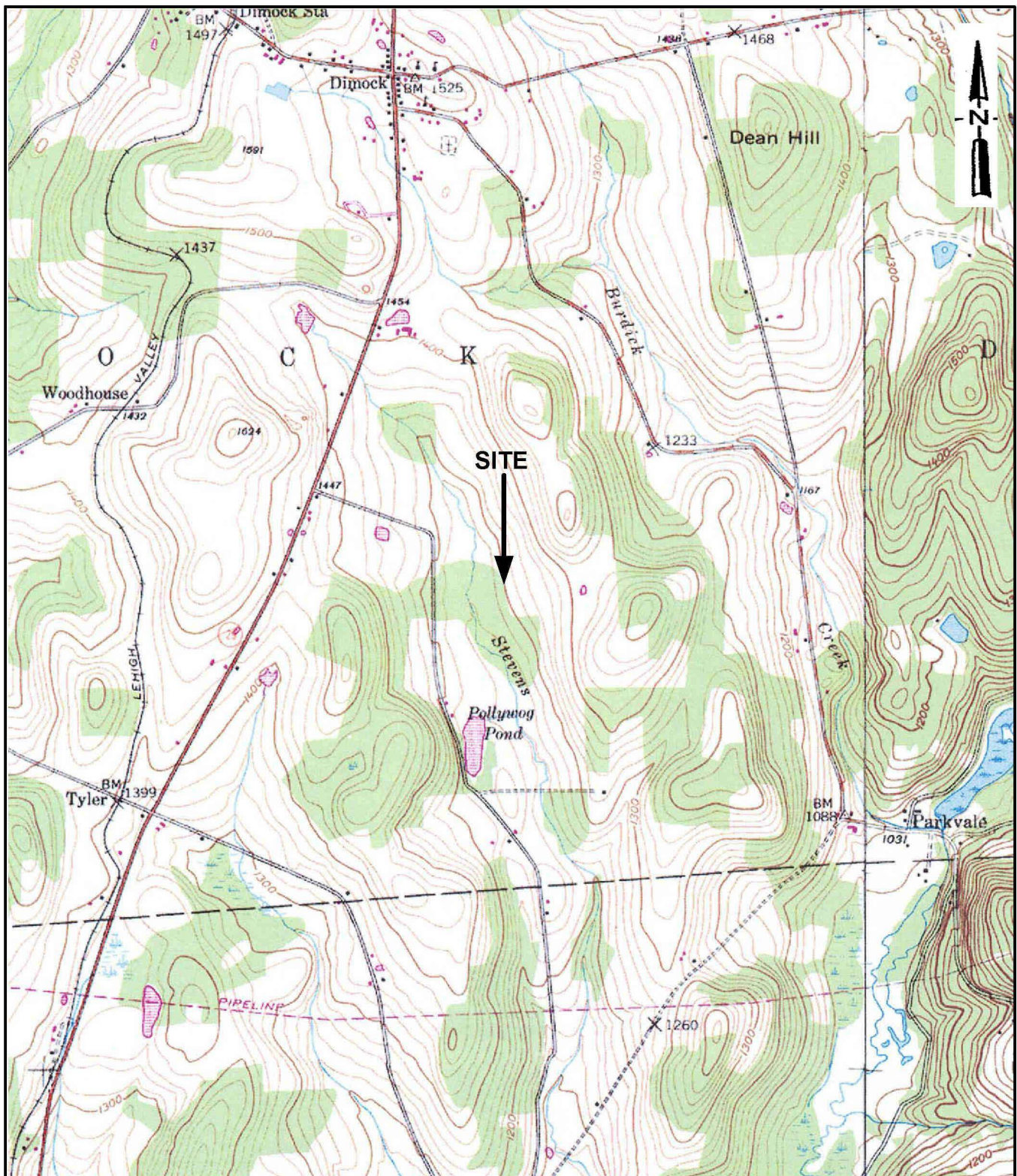
Table 7  
Analytical Results  
Background Sample Results for Metals in Soil  
Heitsman #2V/#4H Wellsite

Dimock Township  
Susquehanna County  
Pennsylvania

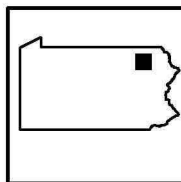
Sample I.D. (Field)	BG-1	BG-2	BG-3	BG-4	BG-5	BG-6	BG-7	BG-8	BG-9	BG-10	SOIL Residential Used Aquifer MSCs <sup>1</sup>	SATURATED SOIL MSCs <sup>2</sup> (0.1 X SHS MSC)
Sample Date	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010	4/27/2010		
Percent Moisture	39.8%	29.4%	51.7%	16.8%	18.3%	19.9%	30.8%	27.4%	33.9%	38.1%	NS <sup>4</sup>	NS
6010/7471 Metals Analyses												
Aluminum	892	8,420	13,100	4,760	13,000	8,930	11,500	12,400	17,600	20,900	190,000	NS
Antimony	ND (0.61) <sup>3</sup>	0.52	1.1	ND (0.48)	ND (0.59)	ND (0.48)	ND (0.66)	ND (0.66)	0.59	ND (0.68)	27	2.7
Arsenic	1.2	3.5	4.8	3.2	3.6	17.7	3.9	6.9	6.3	10.4	12	15
Barium	36.5	25.0	8,040	61.6	59.8	48.4	49.8	89.3	139	192	8,200	820
Beryllium	ND (0.24)	ND (0.20)	0.51	0.20	0.36	0.29	0.31	0.52	0.68	0.79	320	32
Boron	ND (6.1)	ND (5.1)	ND (7.5)	ND (4.8)	ND (5.9)	ND (4.8)	ND (6.6)	ND (6.6)	ND (5.7)	ND (6.8)	60	0.67
Cadmium	ND (0.24)	ND (0.20)	ND (0.30)	ND (0.19)	ND (0.24)	ND (0.19)	ND (0.26)	ND (0.26)	ND (0.23)	ND (0.27)	38	3.8
Calcium	346	ND (202)	2,170	985	503	208	ND (263)	748	1,060	2,320	NS	NS
Chromium	0.81	4.8	13.1	5.0	13.8	9.5	9.1	12.1	16.2	19.7	94	19,000
Cobalt	ND (1.2)	ND (1.0)	8.9	3.8	6.6	5.3	3.2	6.9	8.4	10.9	73	0.81
Copper	1.3	1.6	9.7	3.5	11.3	4.7	6.5	7.8	8.4	14.2	8,200	3,600
Iron	621	2,960	9,680	10,500	17,600	20,800	9,020	15,000	18,500	24,100	66,000	NS
Lead	10.5	13.3	59.0	11.8	11.0	7.1	22.8	15.9	19.3	37.5	450	45
Magnesium	84.5	473	1,760	1,110	3,060	1,860	1,360	2,360	2,990	3,840	NS	NS
Manganese	8.9	10.4	135	240	180	224	52.7	590	573	1,310	31,000	NS
Molybdenum	ND (2.4)	ND (2.0)	ND (3.0)	ND (1.9)	ND (2.4)	ND (1.9)	ND (2.6)	ND (2.6)	ND (2.3)	ND (2.7)	NS	NS
Nickel	ND (2.4)	ND (2.0)	9.4	5.8	15.0	9.7	8.8	12.0	15.2	18.9	650	65
Potassium	142	470	1,560	560	1,230	849	598	1,010	1,510	2,030	NS	NS
Selenium	ND (0.61)	ND (0.51)	ND (0.75)	ND (0.48)	ND (0.59)	ND (0.48)	ND (0.66)	ND (0.66)	ND (0.57)	ND (0.68)	26	2.6
Silver	ND (0.24)	ND (0.20)	ND (0.30)	ND (0.19)	ND (0.24)	ND (0.19)	ND (0.26)	ND (0.26)	ND (0.23)	ND (0.27)	84	8.4
Sodium	ND (611)	ND (506)	ND (750)	ND (484)	ND (589)	ND (480)	ND (657)	ND (662)	ND (573)	ND (685)	NS	NS
Thallium	ND (2.4)	ND (2.0)	ND (3.0)	ND (1.9)	ND (2.4)	ND (1.9)	ND (2.6)	ND (2.6)	ND (2.3)	ND (2.7)	14	1.4
Vanadium	1.5	12.1	16.8	7.5	17.6	14.0	10.9	15.2	20.5	27.4	1,500	2,600
Zinc	10.0	8.7	41.6	21.2	50.7	29.7	28.2	62.7	77.0	104.0	12,000	1,200
Mercury	ND (0.16)	ND (0.13)	ND (0.19)	ND (0.11)	ND (0.11)	ND (0.12)	ND (0.14)	ND (0.13)	ND (0.15)	ND (0.15)	10	1

Notes:  
All results in milligram per kilogram (mg/kg) unless otherwise stated.  
<sup>1</sup> = Medium-Specific Concentrations (MSCs) were established from the Residential, Used Aquifer with TDS < 2500 MSCs Soil to Groundwater Numeric Values listed in Appendix A, Table 3 and Table 4 of 25 PA Code Section 250, Administration of the Land Recycling Act (Act 2) regulations.  
<sup>2</sup> = Saturated soil has an MSC of 1/10 generic SHS MSC according to PA Code §§ 250.308 (2)(ii).  
<sup>3</sup> = ND (0.61) = Parameter not detected at the detection limit specified in parentheses.  
<sup>4</sup> = No standard available.

## FIGURES



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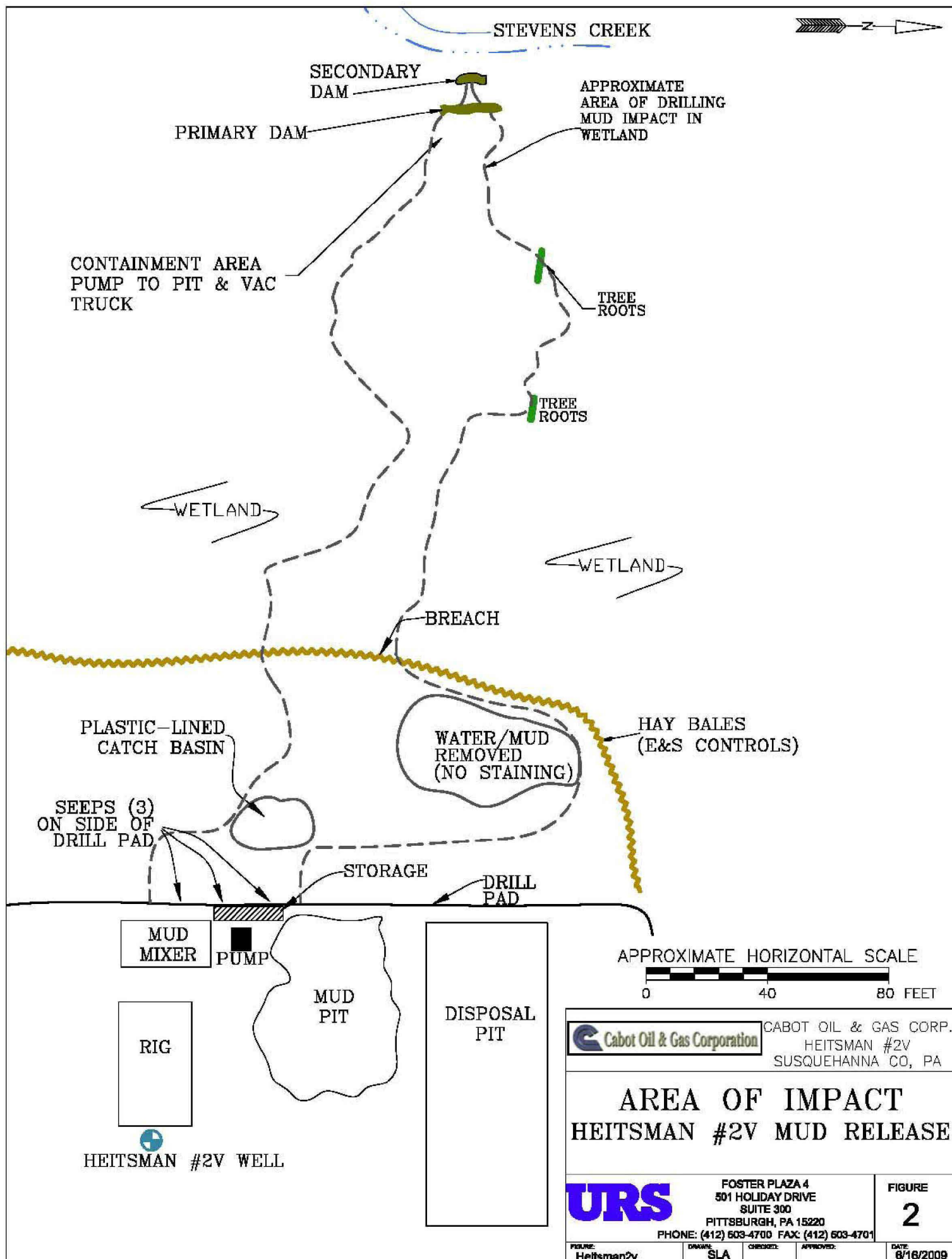


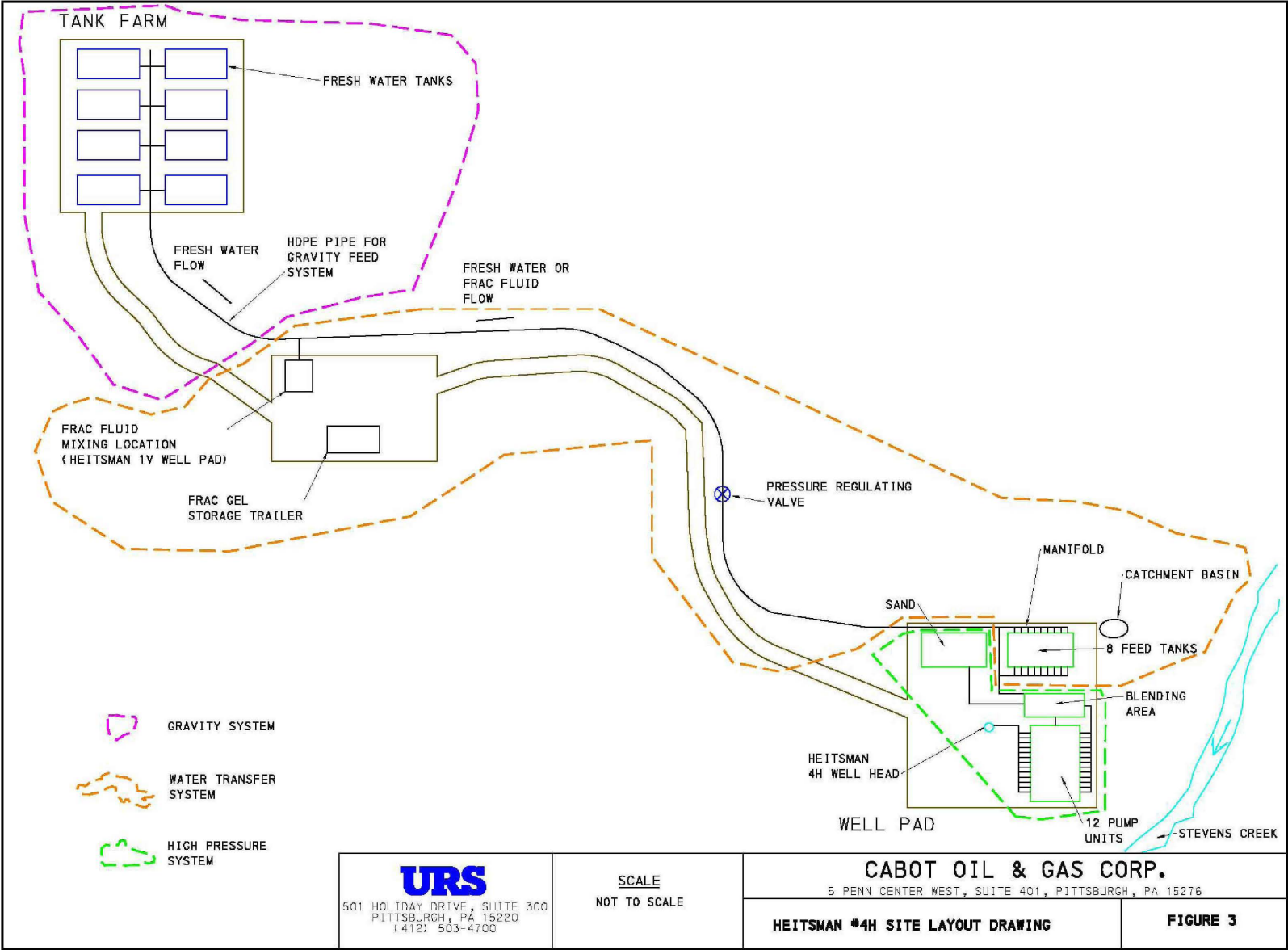
**Cabot Oil & Gas Corporation**

**FIGURE 1  
 SITE VICINITY MAP  
 HEITSMAN #2V/#4H  
 SUSQUEHANNA COUNTY, PENNSYLVANIA**

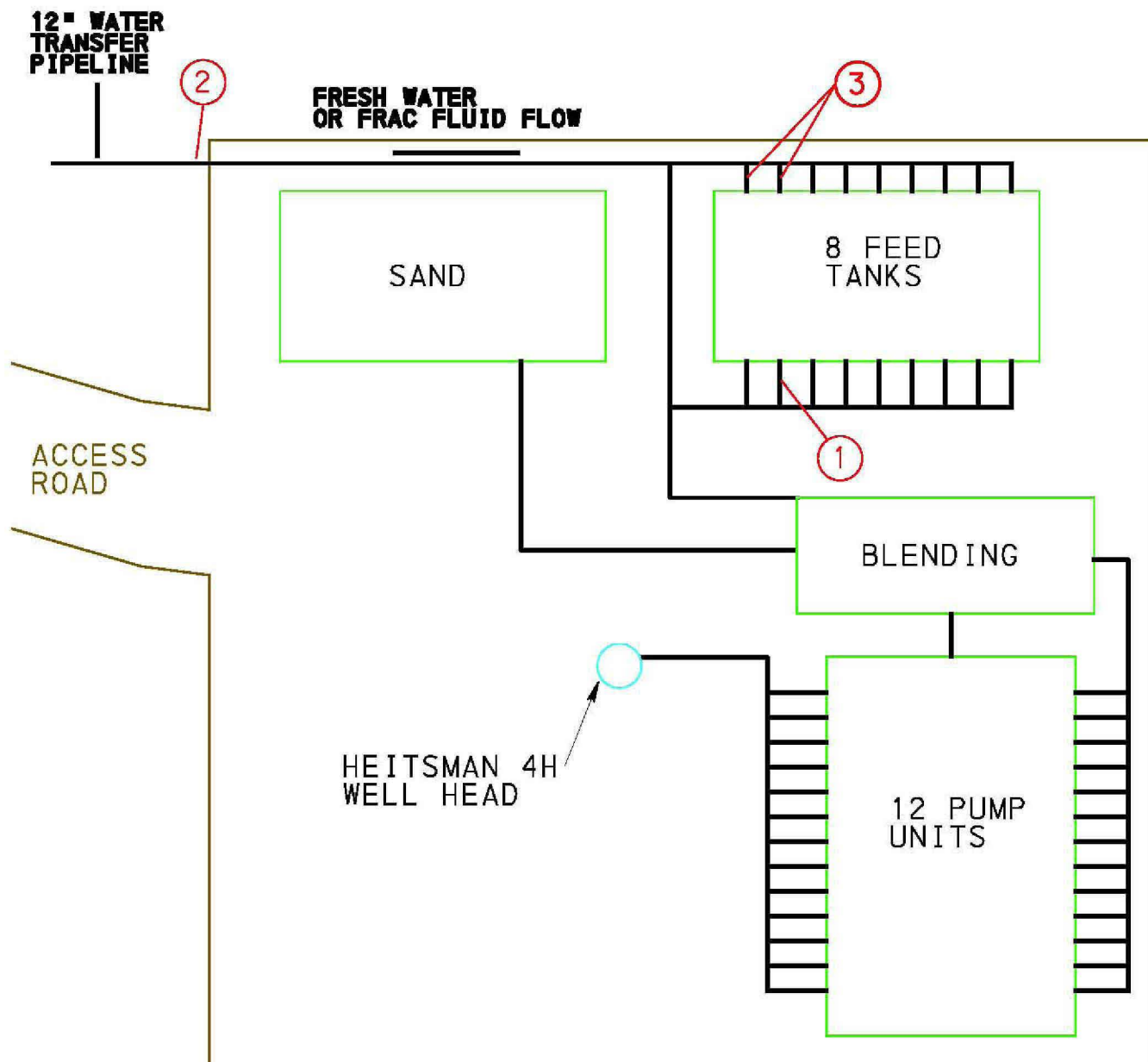
**URS**

BASE MAP SOURCE: USGS 7.5 minute series topographic quadrangle map Montrose West, Pennsylvania (1994), Springville, Pennsylvania (1946, photorevised 1969), and Hop Bottom, Pennsylvania (1994).





- ① September 16, 2009 2:00 PM Release (Disconnected 4" Mechanical Coupling)
- ② September 16, 2009 8:30 PM Release (Failed 12" Mechanical Coupling)
- ③ September 22, 2009 6:30 AM Release (2 Ruptured 8" Hoses)



**URS**

501 HOLIDAY DRIVE, SUITE 300  
PITTSBURGH, PA 15220  
(412) 503-4700

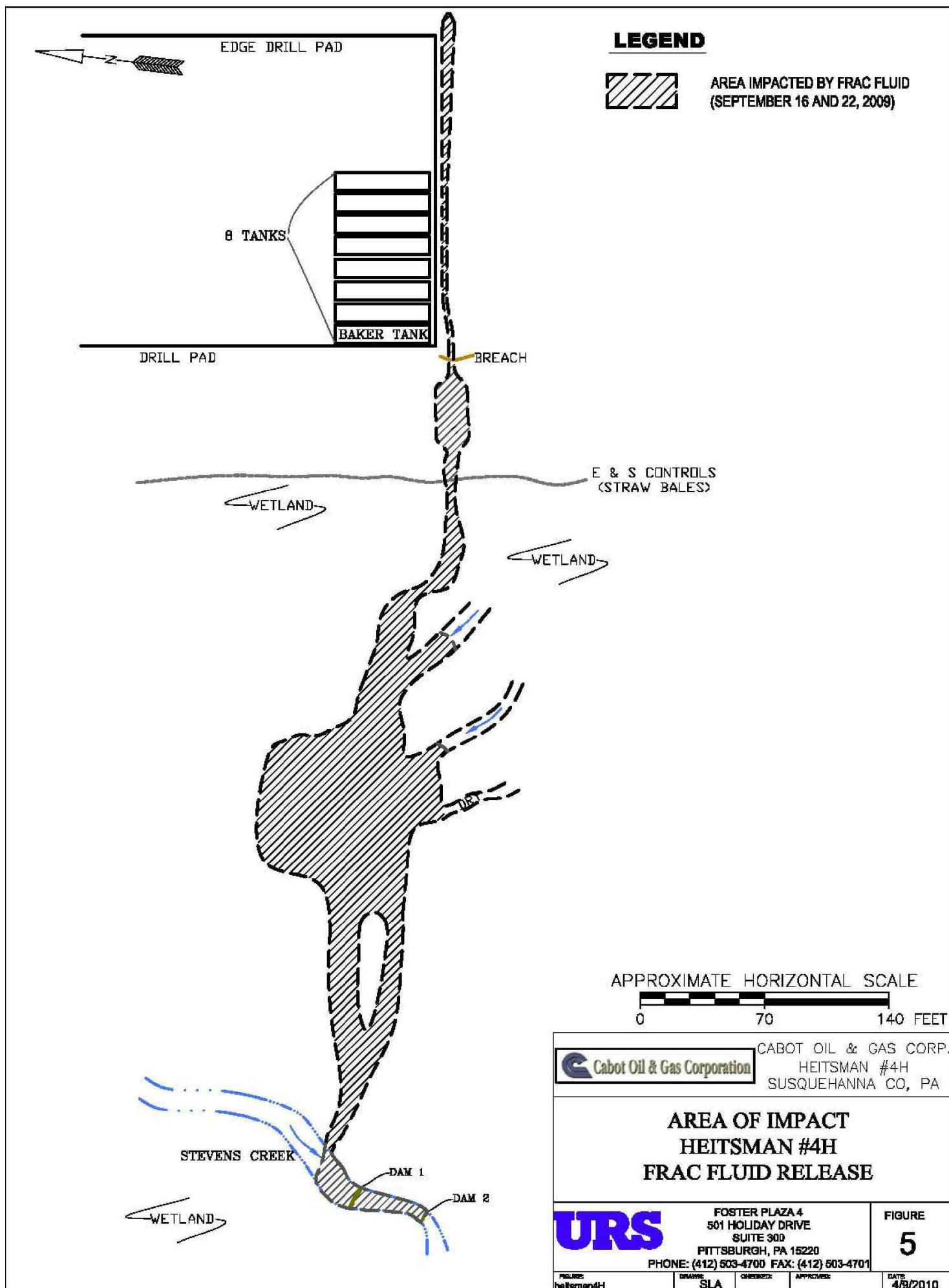
SCALE  
NOT TO SCALE

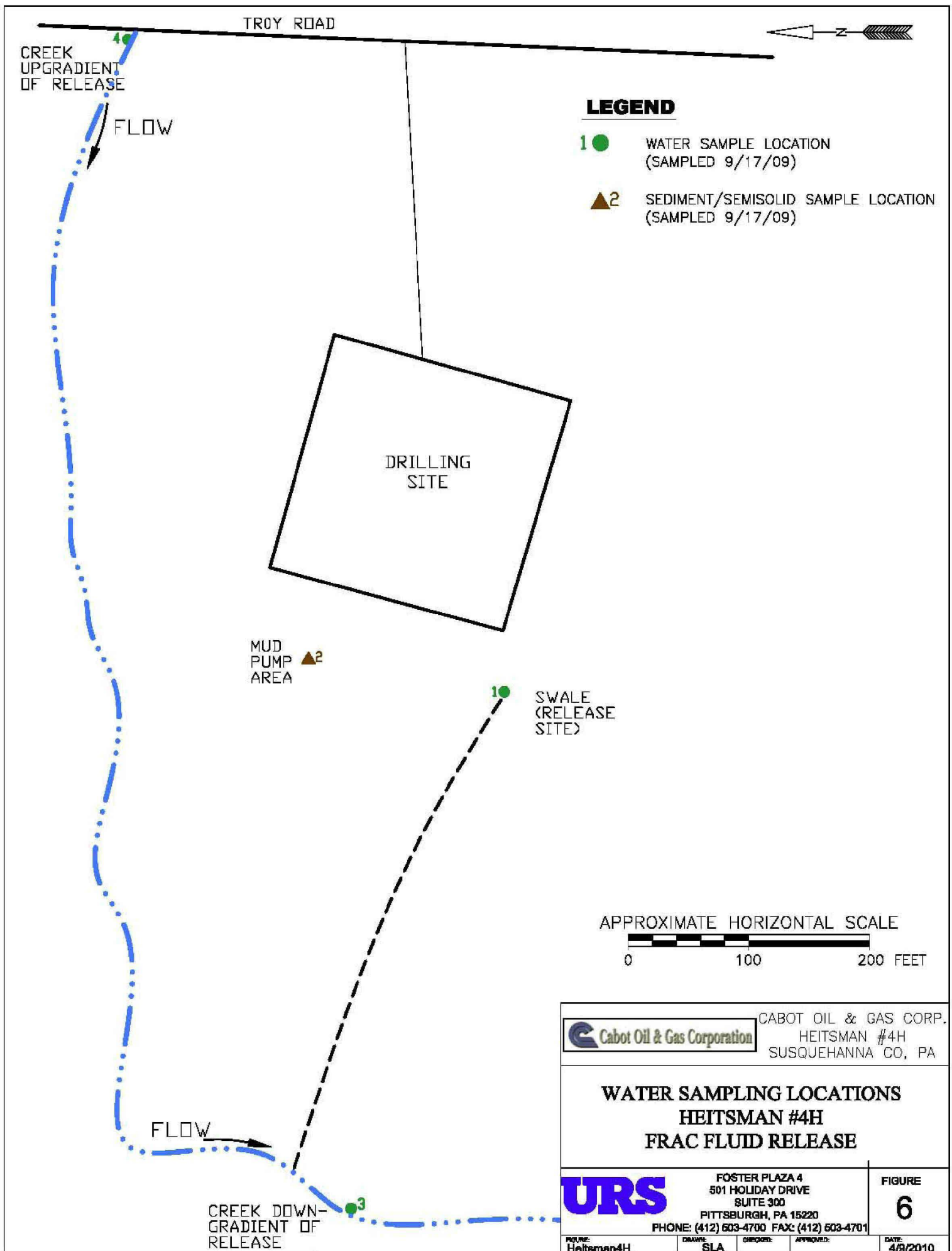
**CABOT OIL & GAS CORP.**

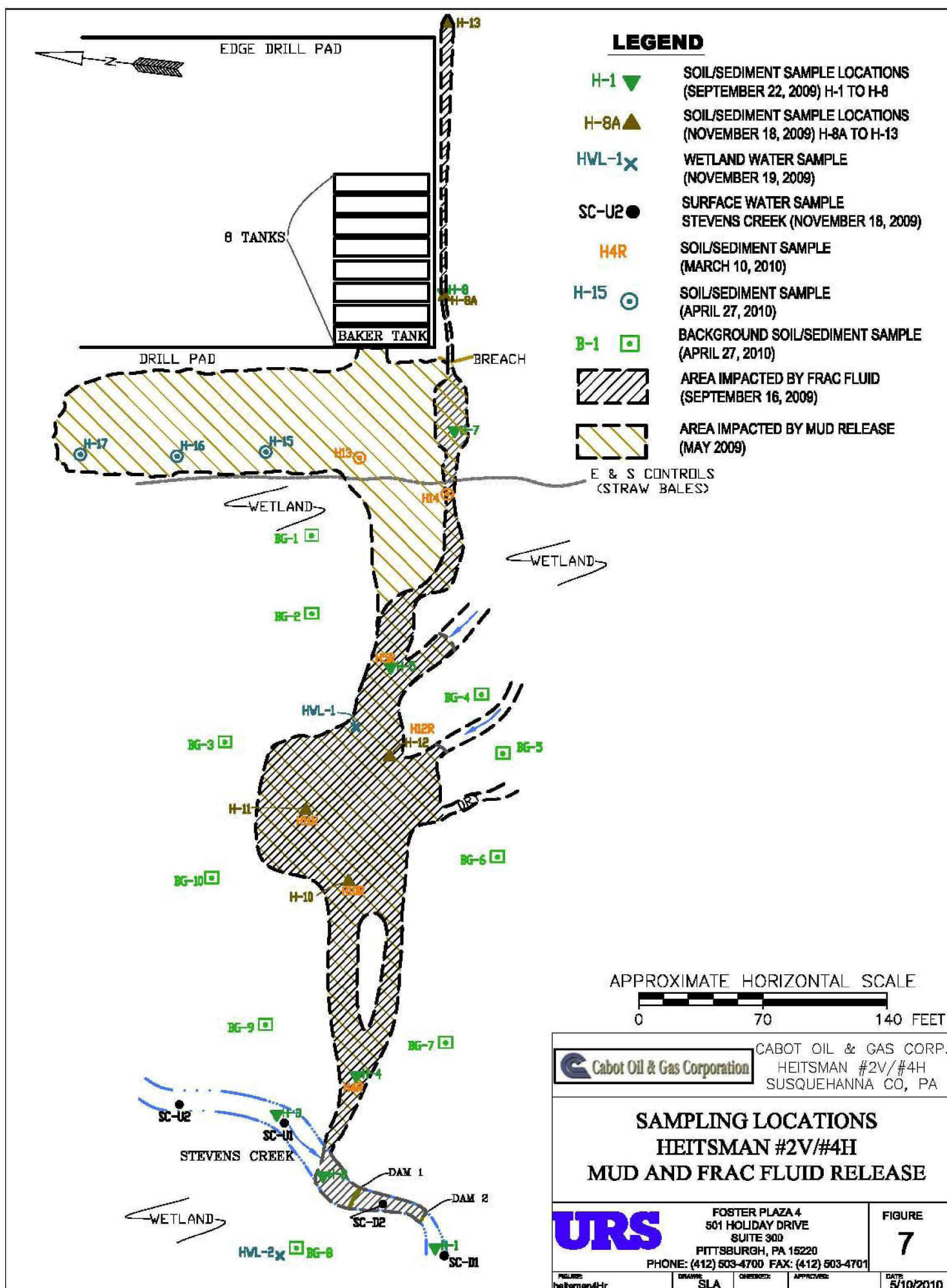
5 PENN CENTER WEST, SUITE 401, PITTSBURGH, PA, 15276

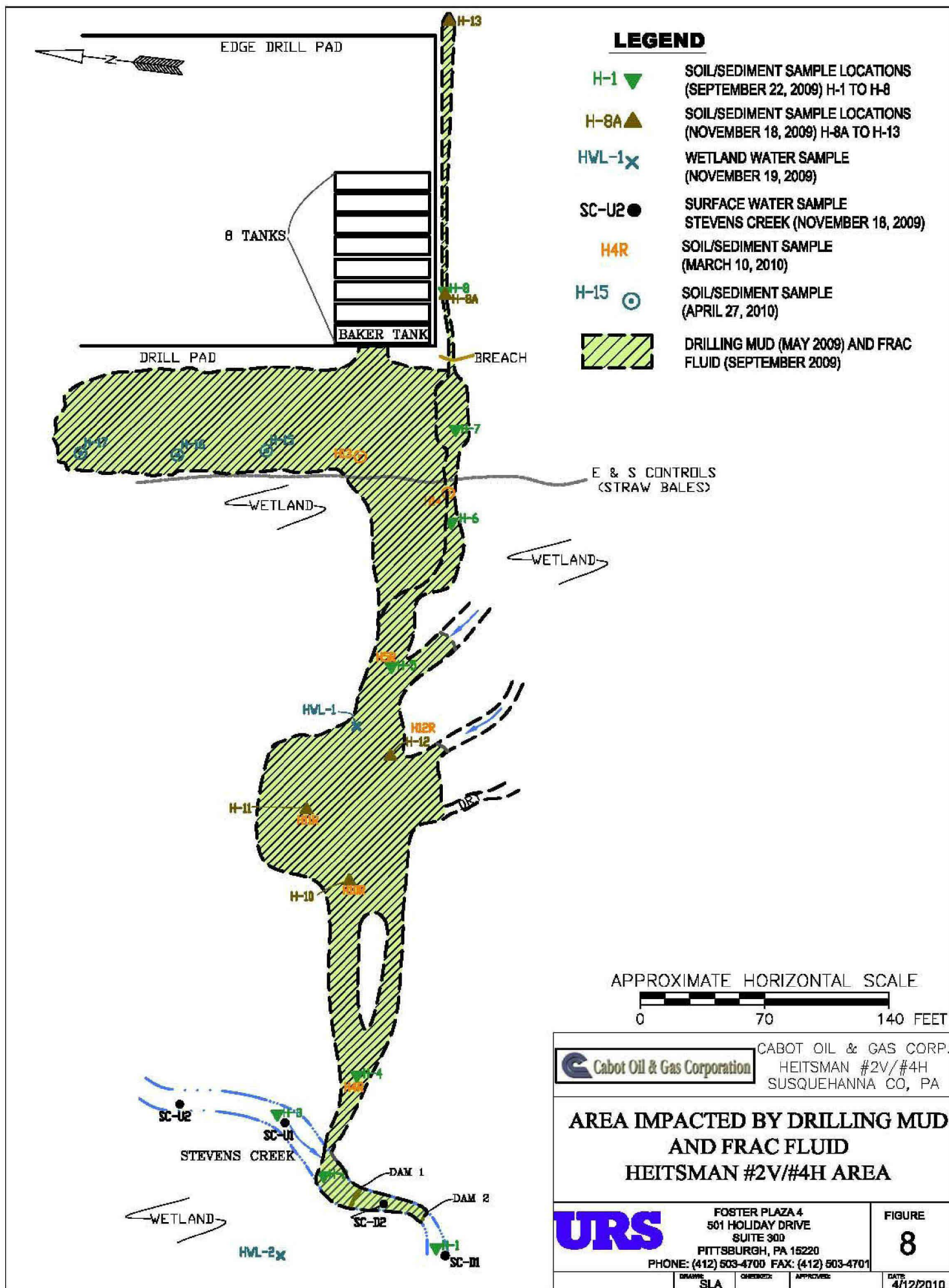
**HEITSMAN #4H WELL PAD  
SCHEMATIC**

**FIGURE 4**









## **APPENDIX A**

### **NOTICE OF INTENT TO REMEDIATE, NEWSPAPER PUBLICATION, AND MUNICIPAL NOTIFICATION DOCUMENTATION**



COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF WASTE MANAGEMENT

## NOTICE OF INTENT TO REMEDIATE

Act 1995-2 requires 4 general informational items to be included in the NIR: the general location, listing of contaminants, intended use of the property, and proposed remediation measures. In addition attach a site map if available.

Property Name Heistman 2V/4H Wellsite

Address/Location Troy Road and Route 19

City Dimock Zip Code 18816

Municipality (if more than one, list all) Dimock Township

County Susquehanna County

Latitude 41 N °(deg.) 43 '(min) 35.238 "(sec) Longitude 75 W °(deg.) 53 '(min) 35.9766 "(sec)

Horizontal Collection Method: USGS Quadrangle

Horizontal Reference Datum: NAD85 Reference Point: Center of drill pad

Wish to participate in the DEP/EPA MOA: ☐

Contact Dave Hess at [dahess@state.pa.us](mailto:dahess@state.pa.us) for details.

EPA ID Number, if known: \_\_\_\_\_

Provide a general description of the site contamination in plain language (e.g. fuel oil spill, historical chemical industrial area contamination), the names of any known primary contaminants to be addressed, and the intended future use of the property:

The Heitsman #2V/#4H Wellsite is being used for the exploration and production of natural gas.

During drilling operations at the Heistman #2V well on May 6, 2009, approximately 825 gallons of drilling mud was released onto the drilling pad, and subsequently entered the nearby vegetated wetland. Immediate action was taken when the release was discovered to clean up and contain as much of the drilling mud as possible by constructing two earthen dams to protect Stevens Creek and further migration into the vegetated wetland, and also act as a holding basin for flushed out drilling mud. Surface water in the vegetated wetland area was the only media affected by the release.

During fracing operations at the Heitsman #4H Wellsite, three releases occurred. Two of the releases occurred on the same day, September 16, 2009, and one release occurred on September 22, 2009. Immediate actions were taken to clean up and contain the frac fluid releases including the creation of a catchment basin to collect pumped frac fluid, flushing the affected areas with fresh water, replacing mechanical connections in hoses, and pumping the recovered frac fluid back to the well pad where it was stored until properly disposed. Surface water, sediment and soil samples were taken in the area that had been impacted and analyzed. The results were compared to background concentrations (for cobalt and lead in soil) and to PADEP cleanup standards (Statewide Health Standards). Attainment of the Background Standard for cobalt and lead in Site soil and the Statewide Health Standard for all other constituents of potential concern has been demonstrated.

The expected future use of the Site will be for the production of natural gas; however, the site has been remediated in compliance with the Background and Residential Statewide Health Clean Up Standards.

Provide a general description of proposed remediation measures:

The Site has been remediated to meet Residential Statewide Health Standards established under the Land Recycling Program. Remedial actions have included the following:

- Immediate measures to eliminate the source of the release;
- Removal of drilling mud and frac fluid from site media (soil, sediment and surface water); and
- Flushing the affected areas with fresh water;
- Properly disposing of impacted fluids at an approved treatment facility in Johnstown, PA.

Will remediation be to a site-specific standard ☐ or as a special industrial area ☐? If so, the municipality or municipalities must be provided 30-day comment period.

Remediator/Property Owner/Consultant. For each of these recipients of the approval of the final report, complete form below.

<b>Remediator</b>
Contact Person: Dan Kania
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Contractor/Remediator
Phone Number: 570-278-7118
Company Name: GasSearch Drilling Services Corporation
Address (street, city, state, zip): 8279 State Route 29, Montrose, PA 18801
Email Address: avannostrand@gdsml.com
<b>Property Owner</b>
Contact Person: Ex. 6 - Personal Privacy
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Owner
Phone Number: Ex. 6 - Personal Privacy
Company Name: N/A
Address (street, city, state, zip): Ex. 6 - Personal Privacy
Email Address:
<b>Property Lessee</b>
Contact Person: Phil Stalnaker
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Lessee
Phone Number: 412-249-3850
Company Name: Cabot Oil & Gas Corporation
Address (street, city, state, zip): 5 Penn Center West, Suite 401, Pittsburgh, PA 15276
Email Address: Phil.Stalnaker@cabotog.com
<b>Consultant</b>
Contact Person: James Pinta Jr., Ph.D., P.G.
Relationship to site (e.g. owner, remediator, participating in cleanup, consultant): Consultant
Phone Number: 412-503-4602
Company Name: URS Corporation
Address (street, city, state, zip): Foster Plaza 4, 501 Holiday Dr, Suite 300, Pittsburgh, PA 15220
Email Address: James_Pinta@urscorp.com

**Preparer of Notice of Intent to Remediate:**

Name: James Pinta, Jr., PhD., PG

Title: Principal Geologist

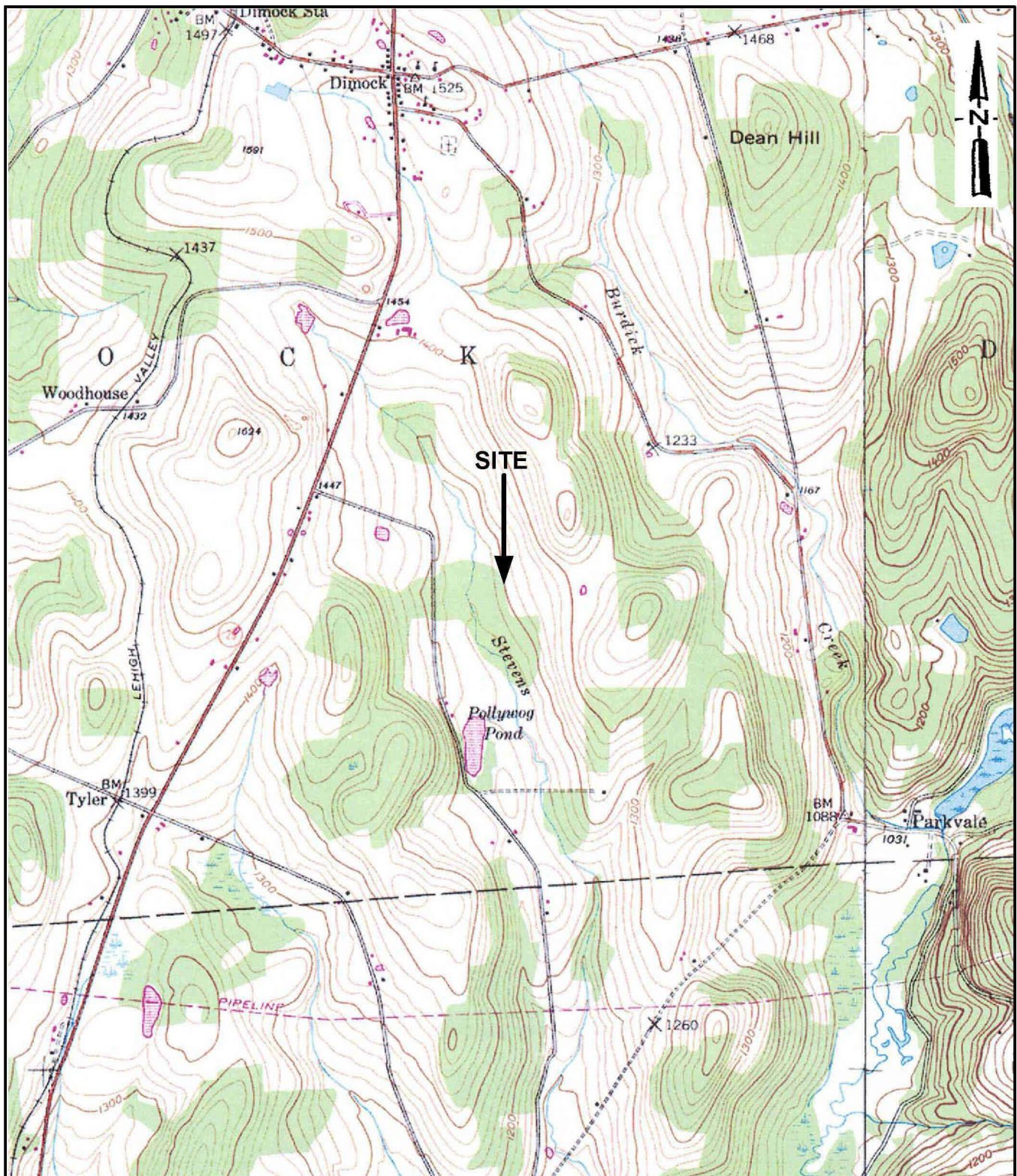
Address: URS Corporation

Telephone: 412-503-4602

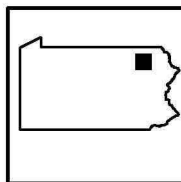
Foster Plaza 4, 501 Holiday Dr, Suite 300

Pittsburgh, PA 15220

Email Address: James\_Pinta@urscorp.com



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 APPROXIMATE SCALE IN FEET

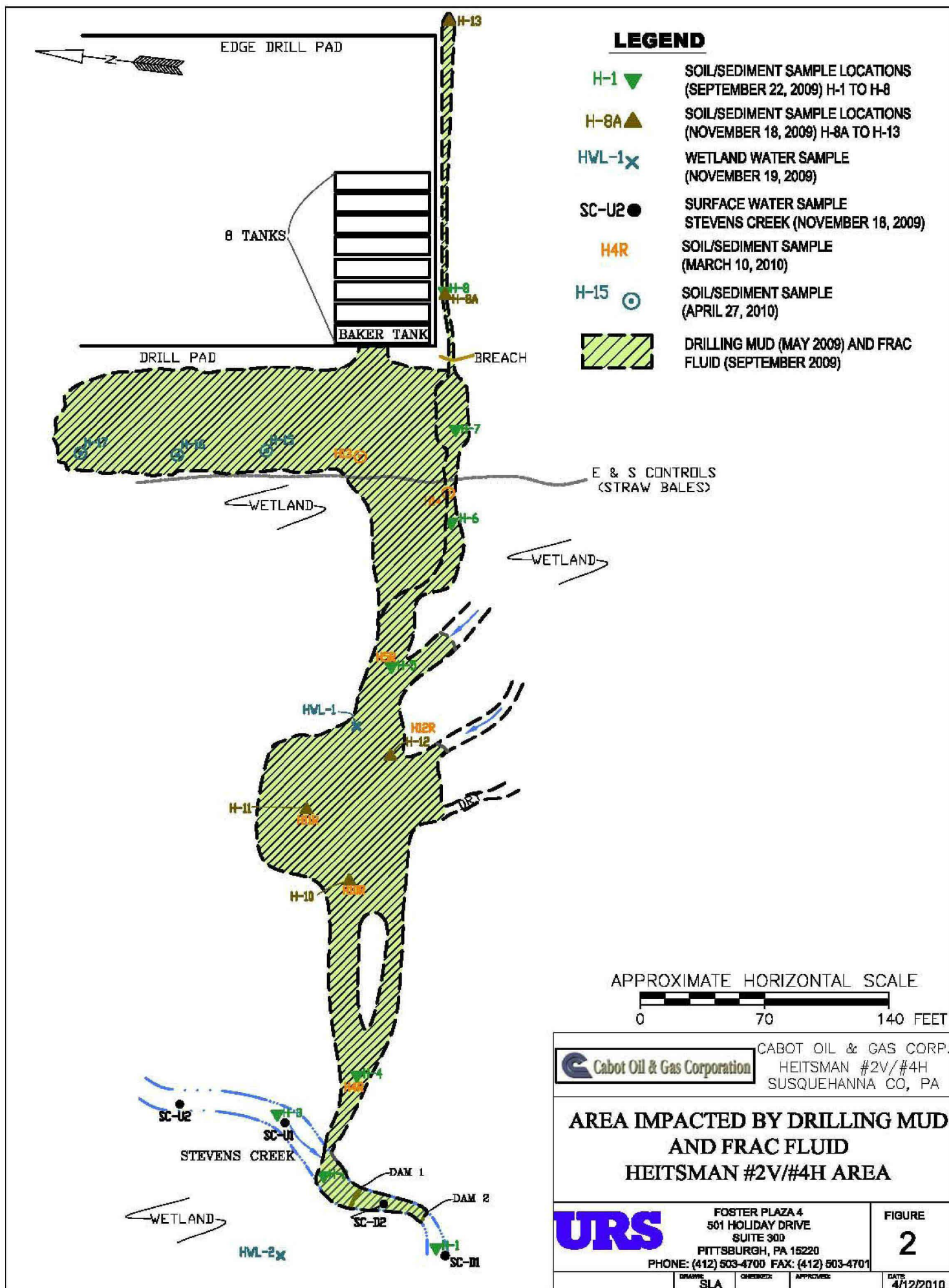


BASE MAP SOURCE: USGS 7.5 minute series topographic quadrangle map Montrose West, Pennsylvania (1994), Springville, Pennsylvania (1946, photorevised 1969), and Hop Bottom, Pennsylvania (1994).



**FIGURE 1**  
**SITE VICINITY MAP**  
**HEITSMAN #2V/#4H**  
**SUSQUEHANNA COUNTY, PENNSYLVANIA**







***SENT VIA CERTIFIED MAIL – RETURN RECEIPT REQUESTED***

May 24, 2010

Mr. Edwin Bunnell, Supervisor  
P. O. Box 65  
Dimock, PA 18816

RE: Heistman #2V/#4H Wellsite  
Dimock Township  
Susquehanna County

Dear Supervisor Bunnell:

Under the provision of the Land Recycling and Environmental Standards Act, the Act of May 19, 1995, P.L. 4, No. 2, notice is hereby given that URS Corporation, on behalf of Cabot Oil & Gas Corporation (Cabot) has submitted a Final Report to the Department of Environmental Protection for the Heistman #2V/#4H Wellsite, Dimock Township, Susquehanna County leased by Cabot. The Final Report documents that remediation activities performed to address a drilling mud release that occurred at the wellsite on May 6, 2009 and three frac fluid releases that occurred at the wellsite September 16 and 22, 2009 have attained compliance with the Background Standard for cobalt and lead in Site soil and the Residential Statewide Health Clean Up Standards under Act 2 for all other constituents of potential concern.

Sincerely,

URS Corporation

James Pinta Jr., Ph.D., P.G.  
Principal Geologist

URS Corporation  
Foster Plaza 4  
501 Holiday Drive, Suite 300  
Pittsburgh, PA 15220

**Legal Notice Submitted to the *Susquehanna County PA Independent Weekender***

**Notification of Receipt of a Final Report  
(Sections 302(e)(2), 303(h)(2))**

Pursuant to the Land Recycling and Environmental Remediation Standards Act, the act of May 19, 1995, P.L. 4, No. 2, notice is hereby given that Cabot Oil & Gas Corporation (Cabot) has submitted to the Pennsylvania Department of Environmental Protection Northeast Regional Office a Final Report for the Heitsman #2V/#4H Wellsite located on leased property located along Troy Road and Route 19, Dimock Township, Susquehanna County, Pennsylvania. The Site had been impacted by a drilling mud release that occurred during drilling operations on the site on May 6, 2009 and three frac fluid releases that occurred on September 16 and 22, 2009 during fracing activities. Remediation measures included the removal of drilling mud and frac fluid from the Site and potable water flushing of surface water and soils impacted by the releases. Cabot has demonstrated that the remediation measures taken have attained compliance with the Background Standard for cobalt and lead in Site Soil and the Statewide Health Clean Up Standards established under the Land Recycling and Environmental Remediation Standards Act for all other constituents of potential concern.



**SENT VIA CERTIFIED MAIL – RETURN RECEIPT REQUESTED**

May 24, 2010

Mr. Edwin Bunnel, Supervisor  
P. O. Box 65  
Dimock, PA 18816

RE: Heistman #2V/#4H Wellsite  
Dimock Township  
Susquehanna County

Dear Supervisor Bunnel:

The Land Recycling and Environmental Remediation Standards Act (Act 2) requires that a Notice of Intent to Remediate (NIR) a site be provided to the municipality in which the site is located. In accordance with this provision of Act 2, we are formally notifying you of our intent to remediate the Heitsman #2V/#4H Wellsite that had a release of drilling mud on May 6, 2009 and three releases of frac fluid; two releases on September 16, 2009 and one release on September 22, 2009. A copy of the Notice of Intent to Remediate, which has been sent to the Pennsylvania Department of Environmental Protection (PADEP), is enclosed. The notice will also be published in the *Susquehanna County Pennsylvania Independent Weekender*, a local newspaper.

Should you have any questions or comments regarding the remediation, please contact Mr. Phil Stalnaker, Cabot Oil & Gas Corporation, at 412-249-3850.

Sincerely,

URS Corporation

James Pinta Jr., Ph.D., P.G.  
Principal Geologist

Attachment: NIR

URS Corporation  
Foster Plaza 4  
501 Holiday Drive, Suite 300  
Pittsburgh, PA 15220

**Legal Notice Submitted to the *Susquehanna County Pennsylvania Independent Weekender***

**Notice of Intent to Remediate to an Environmental Standard  
(Sections 302(e)(1)(ii), 303(h)(1)(ii),  
304(n)(1)(i), and 305(c)(1))**

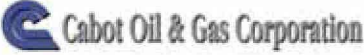
Pursuant to the Land Recycling and Environmental Remediation Standards Act, the act of May 19, 1995, P.L. 4, No. 2, notice is hereby given that Cabot Oil & Gas Corporation (Cabot) has submitted to the Pennsylvania Department of Environmental Protection a Notice of Intent to Remediate (NIR) for the Heitsman #2V/#4H Wellsite located on property leased by Cabot Oil & Gas Corporation (Cabot) located along Troy Road and Route 19, Dimock Township, Susquehanna County, Pennsylvania. This NIR states that the Site is a natural gas wellsite used to produce natural gas. Surface water had been impacted by a drilling mud release that occurred during drilling operations at the Heitsman #2V well on the site on May 6, 2009. Site soil and surface water had been impacted by three frac fluid releases from fracing activities at the Heitsman #4H well that occurred on September 16, 2009 and September 22, 2009. Remediation measures included the removal of the drilling mud and frac fluid from the Site and flushing of surface water and soils impacted by the release using potable water. All recovered materials were disposed of properly offsite. Cabot has demonstrated that the remediation measures taken have attained compliance with the Background Standard for cobalt and lead in Site Soil and the Statewide Health Clean Up Standards established under the Land Recycling and Environmental Remediation Standards Act for all other constituents of potential concern. The proposed future use of the Site is for the production of natural gas; however, cleanup to the Background and Residential Statewide Health Standards allows future use to include residential use.

## **APPENDIX B**

### **SITE PHOTOGRAPHS**





## PHOTOGRAPHIC LOG

<b>Client Name:</b> Cabot Oil & Gas Corporation 		<b>Site Location:</b> Susquehanna County, Pennsylvania	<b>Project No.</b> 39938634.00008
<b>Photo No.</b> 1	<b>Date:</b> 5/08/09		
<b>Direction Photo Taken:</b> North			
<b>Description:</b> Hay bales used as E&S control where drilling mud has breached the containment area (mud flowed under the hay bales). Note drilling mud inside of E&S control.			

<b>Photo No.</b> 2	<b>Date:</b> 5/08/09	
<b>Direction Photo Taken:</b> West		
<b>Description:</b> Drilling mud has flowed into the wetland and impact is confined to a relatively narrow drainageway through the wetland toward Stevens Creek. Note that impact is visually evident.		



## PHOTOGRAPHIC LOG

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<b>Photo No.</b> 3	<b>Date:</b> 5/08/09		
<b>Direction Photo Taken:</b> South			
<b>Description:</b> Drilling mud impact confined to relatively narrow drainageway through the wetland. Note that impact is visually evident with the area of impact (black) within the non-impacted area (brown).			

<b>Photo No.</b> 4	<b>Date:</b> 5/08/09	
<b>Direction Photo Taken:</b> Northwest		
<b>Description:</b> Drilling mud confined to drainageway through wetland. Note that impact is visually evident (black) and easily differentiated from non-impacted area (brown) in upper right of the photograph.		



## PHOTOGRAPHIC LOG

**Client Name:**

Cabot Oil & Gas Corporation

**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**5**

**Date:**  
5/08/09

**Direction Photo Taken:**

North

**Description:**

Secondary dam adjacent to Stevens Creek. Note that no visual impacts to Stevens Creek are observed.



**Photo No.**  
**6**

**Date:**  
5/08/09

**Direction Photo Taken:**

North-northwest

**Description:**

Secondary dam adjacent to Stevens Creek. Note that no visual impacts to Stevens Creek are observed. Note that water behind the dam (to the right) is observed to be visually impacted (black) with drilling mud.

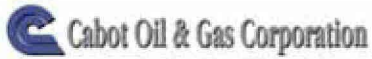




## PHOTOGRAPHIC LOG

**Client Name:**

Cabot Oil & Gas Corporation

**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**

7

**Date:**

5/11/09

**Direction Photo Taken:**

East

**Description:**

Seeps along western portion of the drill pad. Note outlet hose from the mud pump.

**Photo No.**

8

**Date:**

5/11/09

**Direction Photo Taken:**

East-northeast

**Description:**

View of two of the three seeps observed in the vicinity of the mud mixer on the west side of the drill pad. Hose in foreground supplies potable water to the flushing crew remediating the wetland.

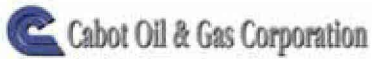




## PHOTOGRAPHIC LOG

**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**9**

**Date:**  
5/11/09

**Direction Photo Taken:**

North

**Description:**

Same area as above showing detail of equipment used during remedial efforts.



**Photo No.**  
**10**

**Date:**  
5/11/09

**Direction Photo Taken:**

Northwest

**Description:**

View of remediated area within the E&S controls, catch basin, pump being used to return flushed water to the disposal pit, and hose supplying potable water to the flushing crew. Note that all visual impacts (black) due to drilling mud spill have been remediated, and only residual soil (brown) is present.

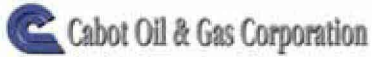




## PHOTOGRAPHIC LOG

**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**11**

**Date:**  
5/11/09

**Direction Photo Taken:**

West

**Description:**

Area remediated in the main portion of the wetland. Note that the wetland is brown and all visual impacts (black) have been flushed from the area as a result of remediation activities.



**Photo No.**  
**12**

**Date:**  
5/11/09

**Direction Photo Taken:**

West

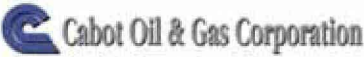

**Description:**

Area remediated in the main portion of the wetland. Note that the wetland is brown and all visual impacts (black) have been flushed from the area as a result of remediation activities. Note pump in the background used to pump water from the containment area to the disposal pit on the drillpad.





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<b>Client Name:</b> Cabot Oil & Gas Corporation 		<b>Site Location:</b> Susquehanna County, Pennsylvania	<b>Project No.</b> 39938634.00008
<b>Photo No.</b> 13	<b>Date:</b> 5/11/09		
<b>Direction Photo Taken:</b> Northwest			
<b>Description:</b> Stevens Creek upstream of the area where the impacted wetland would normally enter the creek. Note lack of visual impacts to the streambed.			

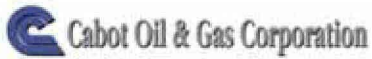
<b>Photo No.</b> 14	<b>Date:</b> 5/11/09	
<b>Direction Photo Taken:</b> Southwest		
<b>Description:</b> Stevens Creek downstream of the area where the impacted wetland would normally enter the creek. Note lack of visual impacts to the streambed.		



## PHOTOGRAPHIC LOG

**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**15**

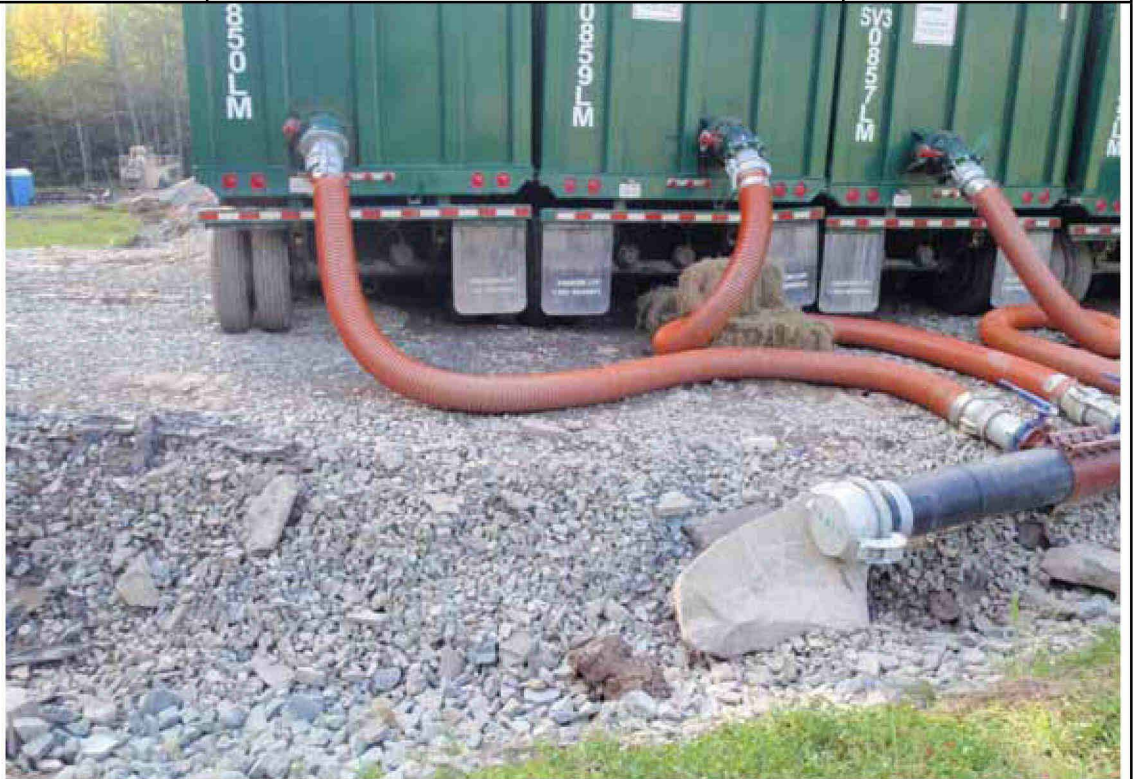
**Date:**  
9/17/09

**Direction Photo Taken:**

North

**Description:**

Drainage swale on south side of well pad containing header connecting multiple Baker Tanks.



**Photo No.**  
**16**

**Date:**  
9/17/09

**Direction Photo Taken:**

West

**Description:**

View of drainage swale, catchment basin and wetland along pathway of migration of released frac fluid.

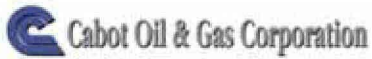




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**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**17**

**Date:**  
9/17/09

**Direction Photo Taken:**

West

**Description:**

View of drainage swale, catchment basin and wetland along pathway of migration of released frac fluid.



**Photo No.**  
**18**

**Date:**  
9/17/09

**Direction Photo Taken:**

West

**Description:**

Hay bale E&S control breached by frac fluid release and pathway of migration of frac fluid into wooded wetland area.





## PHOTOGRAPHIC LOG

**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**19**

**Date:**  
9/17/09

**Direction Photo Taken:**

East

**Description:**

Looking back to Baker Tanks on Heitsman 4H well pad from the wooded wetland area. Note residual pool of fresh water present after fresh water flushing used to remediate the affected area.



**Photo No.**  
**20**

**Date:**  
9/17/09

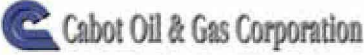

**Direction Photo Taken:**


West

**Description:**

Pooled frac fluid mixed with surface water in Stevens Creek. Stevens Creek was dammed to prevent downstream migration of frac fluid.



<b>Client Name:</b> Cabot Oil & Gas Corporation 		<b>Site Location:</b> Susquehanna County, Pennsylvania	<b>Project No.</b> 39938634.00008
<b>Photo No.</b> 21	<b>Date:</b> 9/17/09		
<b>Direction Photo Taken:</b> West			
<b>Description:</b> Pathway of migration of released frac fluid through the wooded wetland area toward Stevens Creek. Note residual pool of fresh water present after fresh water flushing used to remediate the affected area.			

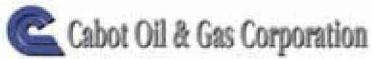
<b>Photo No.</b> 22	<b>Date:</b> 9/17/09	
<b>Direction Photo Taken:</b> West		
<b>Description:</b> Pathway of migration of released frac fluid through the wooded wetland area toward Stevens Creek. Note residual pool of fresh water present after fresh water flushing used to remediate the affected area and the hose used to pump water that had been flushed through the pathway of migration back to the well pad for storage and disposal.		



## PHOTOGRAPHIC LOG

**Client Name:**

Cabot Oil & Gas Corporation

**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**23**

**Date:**  
9/17/09

**Direction Photo Taken:**

East

**Description:**

Containment area near Stevens Creek used to capture fresh water that was flushed through the pathway of migration of the frac fluid and then pumped back to the Heitsman 4H well pad for storage and disposal.



**Photo No.**  
**24**

**Date:**  
9/17/09

**Direction Photo Taken:**

Southwest

**Description:**

Dammed portion of Stevens Creek affected by the frac fluid release. Note milky white appearance of the water.

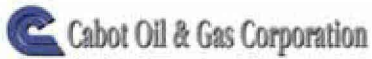




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**Client Name:**

Cabot Oil & Gas Corporation

**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**25**

**Date:**  
9/17/09

**Direction Photo Taken:**

Northeast

**Description:**

Dammed portion of Stevens Creek affected by the frac fluid release.



**Photo No.**  
**26**

**Date:**  
9/17/09

**Direction Photo Taken:**

West

**Description:**

Dammed portion of Stevens Creek affected by the frac fluid release. Note milky white appearance of the water.





## PHOTOGRAPHIC LOG

**Client Name:**

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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**27**

**Date:**  
9/22-23/09

**Direction Photo Taken:**

East

**Description:**

Drainage swale on south side of well pad containing header connecting multiple Baker Tanks.



**Photo No.**  
**28**

**Date:**  
9/22-23/09

**Direction Photo Taken:**

East

**Description:**

Catchment basin at the southwest corner of the well pad. Note that the basin contains fresh water that has been flushed from the drainage swale.



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**Site Location:**

Susquehanna County, Pennsylvania

**Project No.**

39938634.00008

**Photo No.**  
**29**

**Date:**  
9/22-23/09

**Direction Photo Taken:**

East

**Description:**

Catchment basin at the southwest corner of the well pad. Note that fresh water from the basin is being pumped from the basin after being flushed from the drainage swale back up to the well pad for storage and disposal.



**Photo No.**  
**30**

**Date:**  
9/22-23/09

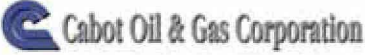

**Direction Photo Taken:**

East

**Description:**

Remediated pathway of migration of frac fluid in the wooded wetland. Note residual pool of fresh water present after fresh water flushing used to remediate the affected area.

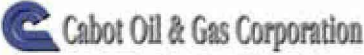



<b>Client Name:</b> Cabot Oil & Gas Corporation 		<b>Site Location:</b> Susquehanna County, Pennsylvania	<b>Project No.</b> 39938634.00008
<b>Photo No.</b> <b>31</b>	<b>Date:</b> 9/22-23/09		
<b>Direction Photo Taken:</b> West			
<b>Description:</b> Remediated pathway of migration of frac fluid in the wooded wetland.			

<b>Photo No.</b> <b>32</b>	<b>Date:</b> 9/22-23/09	
<b>Direction Photo Taken:</b> East		
<b>Description:</b> Remediated pathway of migration of frac fluid in the wooded wetland. Note residual pool of fresh water present after fresh water flushing used to remediate the affected area.		



## PHOTOGRAPHIC LOG

<b>Client Name:</b> Cabot Oil & Gas Corporation 		<b>Site Location:</b> Susquehanna County, Pennsylvania	<b>Project No.</b> 39938634.00008
<b>Photo No.</b> <b>33</b>	<b>Date:</b> 9/22-23/09		
<b>Direction Photo Taken:</b> Northwest			
<b>Description:</b> Remediated portion of Stevens Creek. Note unaffected brown sediment containing naturally occurring, occasional iron staining on sediments and clear appearance of water.			

<b>Photo No.</b> <b>34</b>	<b>Date:</b> 9/22-23/09	
<b>Direction Photo Taken:</b> Northeast		
<b>Description:</b> Remediated portion of Stevens Creek where wooded wetland enters the creek. Note unaffected brown sediment containing naturally occurring, occasional iron staining on sediments and clear appearance of water.		

## **APPENDIX C**

### **MSDS LGC-35CBM**

## **APPENDIX D**

### **DISPOSAL DOCUMENTATION MUD RELEASE**

## **APPENDIX E**

### **DISPOSAL DOCUMENTATION FRAC FLUID RELEASES**

## **APPENDIX F**

### **LABORATORY ANALYTICAL REPORTS**

## **APPENDIX G**

### **STATISTICAL COMPARISON OF LEAD AND COBALT CONCENTRATIONS IN SOILS/SEDIMENT IN REMEDIATED AREAS COMPARED TO BACKGROUND CONCENTRATIONS**